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A Global Pollution Prevention Compendium: Case Studies and Legislative Efforts

Edited by Jacob Manyindo



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A GLOBAL POLLUTION PREVENTION COMPENDIUM: CASE STUDIES AND LEGISLATIVE EFFORTS

**Edited by
Jacob Manyindo**

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Introduction

Pollution prevention (P2) is a process of systematic continuous improvement. It is attained by changing products and consumption patterns, altering the way services are provided, and modifying manufacturing and agricultural practices and processes, all in ways that minimize environmental impacts from their source. Pollution prevention occurs when raw materials, water, energy, and other resources are used more efficiently, less harmful substances substituted for hazardous ones, toxic substances are eliminated from production processes and products, or cleaner technology is employed. These actions are applicable to the public and private sectors of human activity.

The benefits of P2 are immediate and long term. They are realized by producers, as well as society at large, and include increased efficiency gains in resource use, lower costs of production, decreased waste treatment and disposal costs, lower environmental regulation compliance costs, and improved employee and community health and safety.

Over the past decade, National Pollution Prevention Roundtable (NPPR) members have provided pollution prevention regulatory and technical assistance to thousands of industrial, commercial, and agricultural facilities each year. This assistance has helped to enhance the implementation of preventive practices in the U.S.

The incorporation of preventive practices into permitting, enforcement, and compliance has helped to promote P2 regulatory integration in the U.S. P2 regulatory integration involves the incorporation of pollution prevention into existing environmental regulations with the aim of advancing multi-media prevention-based approaches.

This publication presents efforts of NPPR members and affiliates to advance P2. It also presents international efforts to implement and promote P2. This compendium is not meant to provide a detailed description of all P2 efforts underway, but rather a general indication of the extent to which pollution prevention is being applied in the U.S. and around the world. Future efforts of this kind by NPPR will build upon the case studies presented here.

The information contained in this publication provides the following:

1. P2 models for industrial facilities and public sector programs, and a means by which they can compare their P2 efforts with similar efforts being applied elsewhere;
2. Innovative and replicable P2 measures;
3. Evidence of the economic and environmental benefits attained by entities implementing pollution prevention; and
4. Contact data that is part of NPPR's Global Information Network.

All case studies in this publication of industries and governmental organizations in the U.S. implementing P2 were provided by NPPR members and affiliates. International case studies were obtained from the Cleaner Production Program of the United Nations Environment

Program, the United States Agency for International Development – Environmental Pollution Prevention Project (EP3), and the NPPR's International Activities Department.

How to use this book

This book is arranged in two sections.

- Section 1: Demonstrates efforts by industries and governmental organizations to implement P2 in various states in the U.S. It also presents international illustrations of industries from Africa, Asia, Australia, Europe, and South America that have implemented P2 measures. The states in the U.S. and nations of the world are listed in alphabetical order. The costs and savings (in US\$) and the environmental benefits are indicated in each case study.
- Section 2: Introduces efforts being made by state governments in the U.S. to incorporate P2 into existing state and federal environmental regulations. This section also presents attempts by various European and Asian countries to incorporate P2 into their environmental regulations. The states in the U.S. and nations of the world are alphabetized. Specific examples of the implementation of P2-modified regulations are presented where they exist.

What is the National Pollution Prevention Roundtable?

The National Pollution Prevention Roundtable is the largest membership organization in the United States devoted exclusively to promoting pollution prevention. NPPR provides a national forum for advancing the development and implementation of pollution prevention, and through which efforts to avoid, eliminate, or reduce pollution at its source can be evaluated.

NPPR has a voting membership composed of state, local and tribal government pollution prevention programs, as well as Small Business Assistance providers. Affiliate members include representatives from federal agencies, non-profit organizations, trade associations, academic institutions, and private industry. NPPR members are located in every state and operate programs that provide pollution prevention regulatory and technical assistance to thousands of industrial, commercial, and agricultural facilities each year. This information helps many of these facilities reduce the costs of production and environmental compliance, which leads to improved efficiency and competitiveness.

Annual conferences hosted by NPPR attract more than six hundred participants, and provide a forum for exchanging the latest in pollution prevention research, policy issues, funding opportunities, and technical expertise. NPPR, located in Washington, D.C., provides members with access to pollution prevention information on regulatory and legislative developments, technologies and technical assistance, and publications of state, local and other programs.

To learn more about NPPR, or to find out how to become a member, please contact us at (202) 466-P2P2. NPPR also operates a web site at www.p2.org.

Abbreviations

BACT – Best Available Control Technology

BOD – Biological/Biochemical Oxygen Demand

Btus – British thermal units

CAA/CAAA – (Clean Air Act) Amendments

°C – degrees Celsius

CFC – chlorofluorocarbons

CO₂ – Carbon dioxide

COD – Chemical Oxygen Demand

CP – cleaner production

EPA – Environmental Protection Agency

gpd – gallons per day

HAP – hazardous air pollutant

IPA – isopropyl alcohol

Kgs - kilograms

kWh – kilowatt-hours

lbs. – pounds

LQG – large quantity generator

MACT – Maximum Available Control Technology

NPDES – National Pollutant Discharge Elimination System

NSR – New Source Review

ODC – ozone-depleting chemical

POTW – Publicly Owned Treatment Works

P2 – pollution prevention

ppm – parts per million

RACT – Reasonably Available Control Technology

RCRA – Resource Conservation Recovery Act

SEPs – Supplemental Environmental Projects

SQG – small quantity generator

TCA – trichloroethane

TCE – trichloroethylene

TRI – Toxics Release Inventory

TURA – Toxics Use Recovery Act

VOC – volatile organic compound

SECTION ONE

P2 Case Studies in the United States

Alaska

Highly Efficient Alaska Businesses

P² Technique: Inventory Control, Energy Efficiency, Process Modification

Contact Information: David Wigglesworth

Pollution Prevention Office

Alaska Department of Environmental Conservation (ADEC)

555 Cordova Street, Anchorage, AK 99501

(907) 269-7582

Several businesses in Alaska have adopted P2 measures that helped reduce operating costs, ensure compliance with regulations, make operations run more smoothly and efficiently, and improve worker health and safety. The P2 measures that have been adopted have improved the overall competitiveness of these businesses.

- Fort Wainwright's Public Works supply warehouse has adopted a "Just In Time" inventory approach which only allows shops to keep a limited supply (15 days) of hazardous materials. This has helped reduce spills, spoilage, and damage of materials, as well as storage costs.
- Eielson Air Force Base has started "Hazmart," a single, controlled location for obtaining hazardous materials. The Hazmart has been successful in eliminating overstock of hazardous materials and in reducing unnecessary use of materials, through an approved system that limits access to hazardous materials.
- Many non-manufacturing facilities find most of their energy use is due to heating, ventilation, and air conditioning systems. In order to save energy, many facilities are improving the "shell efficiencies" of buildings through weather-stripping, window treatments, proper planting of trees and shrubs, etc.
- The U.S. Army Corps of Engineers suggest designs to their clients that conserve water and energy. For example, the Corps designed a laundry facility where rejected heat from the laundry equipment is used to pre-heat the water used in the laundry cycle. The Corps also designed an air conditioning system that uses cold groundwater as the cooling medium, which is then routed to a landscaping fountain to save energy and prevent wastewater.
- The Anchorage School District Facility Maintenance Department switched to a small-scale solvent recovery system after conducting a waste reduction audit and reviewing its options. The new system reduced solvent waste and saved over \$18 per gallon of used solvent. Additional savings were derived from reduced cost of regulatory compliance. This system allowed school district facility to maintain SQG status.

Source: Alaska Department of Environmental Conservation, June 1997. *Habits of Highly Efficient Alaska Businesses: A Guide to Staying Competitive While Protecting the Environment.*

Dowell/Schlumberger Facility Reconstruction

P² Technique: Material Substitution, Inventory Control

Contact Information: David Wigglesworth

Pollution Prevention Office

Alaska Department of Environmental Conservation (ADEC)

555 Cordova Street, Anchorage, AK 99501

(907) 269-7582

After burning in a fire in 1990, the facility was reconstructed with pollution prevention in mind. For example, acid storage tanks were located inside the building to reduce the risk of acid spills. A coded concrete containment structure was installed, with a double liner and a design to allow for visual leak detection on a periodic basis. Drums were replaced with reusable 300-gallon tote containers wherever volume was significant enough to justify the change. Instead of using 150 gallons of lubrication oil each time the triplex pumps are serviced, lubricating oils are now recycled. The on-site recycled lubricating oil system cost \$1,000 to install. A wastewater recycling system was also installed.

Results

- \$1,000 payback in less than a year for the recycled lubrication oil system.
- Reduced spill potential.
- Reduced labor requirements to keep pumps oiled.
- Fewer incidents of burned out pumps.
- Acid spills due to interior location of acid storage tanks were reduced.
- The volume of water used and disposed due to the water recycling system decreased.

Source: Alaska Department of Environmental Conservation, Pollution Prevention Office. 1994. *Pollution Prevention Opportunities for the Oil Field Service Industry*.

Arizona

Motorola

P² Technique: Input Substitution, Process Modification

Contact Information: Jim Landers

Motorola Government Space and Technology Group

Scottsdale, AZ

(602) 441-3600

Chemical fluxes are used to remove oxides from metal surfaces prior to circuit board soldering. These chemical fluxes produce corrosive residues. Ozone depleting chemicals (ODCs) such as Freon 113 and trichloroethane (TCA) are used to rinse the corrosive residues from the metal surfaces. In the effort to eliminate the emission of ODCs, Motorola developed a soldering process that doesn't require chemical rinses. This process replaces flux with a fluid that is a 2% mixture of adipic acid in isopropyl alcohol. Adipic acid is a safe, nontoxic, organic acid used in the commercial food industry as a neutralizer and flavoring agent.

Results

- Each machine that employs the new soldering process now saves between \$50,000 and \$245,000 per year in chemical uses alone. These savings offset the additional \$40,000 to \$100,000 required to modify the equipment used in the old soldering process.

- Emissions of Freon 113 and TCA have been eliminated.
- Motorola received the U.S. EPA's Stratospheric Ozone Protection Award.

Source: United States Environmental Protection Agency, Office of Pollution Prevention and Toxics. April 1996. *Pollution Prevention Success Stories*.

California

Specific Plating Company

P² Technique: Process Modification

Contact Information: Regional Water Quality Control Plant (RWQCP)

2501 Embarcadero Way

Palo Alto, CA 94303

(415) 329-2598

During the Specific Plating Company's plating process, parts are plated in tanks containing metals such as copper, nickel, zinc, silver, and gold. After each plating process, a rinse tank is used to wash any excess metal solutions from the parts. The water in the rinse tanks must be continuously replaced and, therefore, metal-containing wastewater is generated. The RWQCP asks companies to reduce metal discharges in their wastewater so that it may in turn reduce its discharge of metals into the San Francisco Bay. As a result, several pollution prevention projects have been used to reduce materials and water use, thereby reducing wastewater metal discharges to the RWQCP and minimizing company operating costs. These projects are:

- Conversion to deionized water for bath make-up and rinsing;
- Installation of process control measures to minimize water use and baths solution waste, such as drag-out rinse tanks after the plating process to capture metals and allow their reuse;
- Addition of process tank conductivity controllers to minimize make-up water and chemical use; and
- Installation of an electrolytic recovery unit to capture metals from drag-out.

Results

Project	Costs (\$)	Annual Savings (\$)	Payback (years)
• Deionized Make-Up Water	2,000	1,200	1.7
• Process Control Measures	24,000	11,000	2.2
• Rinse Station Water Recycling	16,500	11,000	1.5
• Process Productivity Controllers	15,000	5,100	2.9
• Electrolytic Recovery Unit	5,000	1,700	2.9
TOTAL	62,500	30,000	2.1

<u>Discharge/Disposal</u>	<u>% Reduction</u>
• Copper Discharges	88%
• Nickel Discharges	85%
• Wastewater Discharge Flow	27%
• Off-Site Sludge Disposal	53%

Source: City of Palo Alto. August 1996. *Pollution Prevention at Specific Plating Company*.

Sonatech, Inc.

P² Technique: Process Modification, Input Substitution

Contact Information: Laura Cyr

879 Ward Drive

Santa Barbara, CA 93111

(805) 683-1431

Sonatech purchased and installed a water-based cleaning system for printed circuit board defluxing. The firm previously used TCA and IPA to clean their boards. The alternative cleaning system cost \$20,000. The Santa Barbara Air Pollution Control District, Southern California Edison and Unit Design, the equipment manufacturer, shared the cost of the new cleaning system equipment; therefore, the total cost to Sonatech was about \$2,000. Sonatech also acquired an evaporator to treat the wastewater from its aqueous cleaning process.

Results

- Annual TCA emissions declined from 149 pounds in 1992 to zero in 1997.
- Annual IPA emissions of 366 pounds in 1995 were eliminated by 1997.
- Axarel (a VOC cleaner) emissions of 102 pounds in 1994 were also eliminated by 1997.

Source: Institute for Research and Technical Assistance. February 1997. *Pollution Prevention Center: Santa Barbara Activities*. Santa Monica, CA.

Southern California Metal Finishing P2 Project

P² Technique: Process Modification

Contact Information: Alice Tobriner

EPA Region 9

75 Hawthorne Street

ZMD4-4

San Francisco, CA 94105

(415) 744-1700

EPA Region 9's Merit Partnership for Pollution Prevention, in conjunction with the Metal Finishing Association of Southern California and the California Manufacturing Technology Center, established a program that implements P2 techniques and technologies in seven southern California metal finishing facilities. P2 implementation involved, for example, reducing drag-out with the use of spray rinses.

Results

- Drag-out from nickel plating lines was reduced by 58% after the introduction of spray rinses.
- Spray rinses reduced drag-out from the chrome plating lines by 64%.
- Savings associated with the recovery and reuse of the chrome and nickel plating solutions, and the reduction in the amount of rinse water required resulted in a payback period of 0.6 years for the new spray rinse equipment that was installed.

Source: Alice Tobriner. May 1998. *The Merit Partnership for Pollution Prevention*. EPA Region 9.

Colorado

Sand Creek Chemical L.P.

P² Technique: In-Process Recycling

Contact Information: Mark Ebson

4150 East 60th

Commerce City, CO 80020

(303) 286-7233

Sand Creek Chemical L.P. used natural gas and steam in its methanol manufacturing process. A mixture of 85% methanol and 15% water was produced and distilled. Wastewater from this process containing some methanol was sent to the POTW. The new system attempted to remove the methanol from the wastewater by reusing 20% of it and pumping it back into the steam system. Wastewater was sent to a 20,000 gallon holding tank where it was sampled and methanol removed before final discharge to the POTW. The installation of two 20,000-gallon storage tanks cost \$50,000 (one was a backup storage tank).

Results

- 20% (2,000 gallons/day) of the water was reused in the new system thereby saving \$2,200/year.
- Regulatory compliance costs and liabilities were reduced.
- Sand Creek's business image was enhanced.
- More than \$1,000/year was saved in POTW surcharges and discharge fines.

Source: Canterbury, J. and Kolwey, N. September 1996. *Colorado Pollution Prevention Case Studies Compendium*. Pollution Prevention Program, Colorado Department of Public Health and Environment.

Denver International Airport

P² Technique: Process and Equipment Modernization, Energy Efficiency

Contact Information: Dave Duster (EPA Region 8) or Jim Piatt (Denver Airport Office)

(303) 270-1992

The multitude of hazardous emissions in the day-to-day operations of an airport are usually dealt with by "end-of-pipe" controls. At the new Denver International Airport (DIA), pollution prevention and energy conservation were incorporated into the design and construction of the airport. Some of the pollution prevention measures implemented included:

- wastewater volume reduction by using ultra-low flow toilets, reclaiming wastewater for irrigating outside vegetation, and landscaping with water-stingy plants;
- above ground storage tanks with floating roofs to prevent groundwater contamination from corrosion-produced leaks (a major problem at airports);
- development of a solid waste management plan by EPA's onsite coordinator to reduce solid waste generation by 30%; and
- addressing energy conservation through efficient lighting consistent with the EPA's Green Lights Program.

Results

- 95% of glycol deicing agents applied to aircraft were recovered and reused.
- Annual savings in glycol purchases amounted to 760 tons per year (\$650,000).
- 700 million gallons of water were saved per year (\$1.5 million).
- Nitrogen oxide and carbon monoxide emissions were reduced by almost 100 tons per year.

- Over 50 tons per year of volatile organic emissions were eliminated.
- There was a 30% reduction of solid waste generation (\$32,000 in disposal savings).

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

Connecticut

The Hartford Courant

P² Technique: In-Process Recycling

Contact Information: The Hartford Courant

285 Broad Street
Hartford, CT 06115
(203) 275-1917

This regional newspaper generates about 175 gallons of waste ink each week. Waste ink is hazardous, especially if it contains chromium or lead. The newspaper used to ship the waste off-site for reuse as a supplemental fuel. It now collects the waste, recycles solvent, and blends the waste ink back into the virgin black ink for reuse. Operation of this waste ink recycling option costs \$7,100 per year. Its purchase and installation cost \$318,000.

Results

- Reduction in the toxicity and quantity of the waste ink from 9,100 gallons of waste ink and solvent per year to 46 gallons of paper dust and 3,050 gallons of water. This reduction has allowed the newspaper to report its emissions as a SQG.
- The elimination of disposal costs saved \$38,000 per year.
- The value of the recycled product is almost \$20,000 per year and when this is added to the difference in operating costs, the total savings are \$50,000 per year.
- The recycling option's purchase and installation cost payback period is 6.5 years.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

Delaware

DuPont White Pigment and Mineral Products

P² Technique: Process Modification, Input Substitution

Contact Information: Andrea Farrell

Pollution Prevention Program
Delaware Department of Natural Resources and Environmental Control
89 Kings Highway
Dover, DE 19903

The EdgeMoor Plant manufactures Titanium Dioxide (TiO₂), a white pigment that is used in food-grade markets and in the paint, coatings and paper industries. During the manufacturing process, titanium tetrachloride (TiCl₄) must be cooled to a liquid form before conversion to TiO₂. This was accomplished by a refrigeration condenser that traditionally used methylene chloride as its refrigerant. Methylene chloride (a carcinogen and hazardous waste listed under TRI) was one of the several by-products generated by this process. After researching several safe alternatives to methylene chloride, the plant

converted the process condenser to calcium chloride, a non-hazardous salt. Implementing this change cost \$2 million.

Results

- The elimination of methylene chloride emissions (20,000 pounds per year).
- Calcium chloride does not vaporize therefore no fugitive emissions are generated.
- Calcium chloride is non-hazardous thus regulatory reporting requirements for this process step have been eliminated.
- Risk of worker exposure was greatly reduced.

Source: Pollution Prevention Program, Department of Natural Resources and Environmental Control. Undated. *Delaware Industries Prevent Pollution.*

Chrysler Newark Assembly Plant

P² Technique: Process and Equipment Modification, Input Substitution, Inventory Control

Contact Information: Andrea Farrell

Pollution Prevention Program
Delaware Department of Natural Resources and Environmental Control
89 Kings Highway
Dover, DE 19903

A pollution prevention team was formed to develop ways to reduce the volume of solvent-containing chemicals, thereby reducing VOC, TRI and HAP emissions at the plant. The team used several methods to achieve the solvent reductions, including:

- Full body powder was introduced, virtually eliminating associated VOCs and HAPs.
- The use of water-based, instead of solvent-based deadner fluid, was introduced thereby eliminating the TRI chemicals associated with the solvents.
- Switching to lower HAP content paint mixtures.
- Removing unnecessary solvents and switching to prepackaged solvent wipes resulted in major VOC reductions.
- Switching to a glycol ether free cleaner for use in the post-welding body washer.
- Reduced VOC purchases in booth cleaner material due to improved maintenance practices and strict inventory control.
- The purge solvent recovery system was redesigned and ongoing process checks instituted.

Results

- TRI releases were reduced from 9.3 pounds per vehicle in 1993 to 6.7 pounds per vehicle in 1994.
- Reductions on the releases of the following were also experienced: booth cleaner by 28%, purge recovery by 20%, xylene by 93%, naphtha by 72%, lacquer thinner by 76%, and isopropyl alcohol by 41%.

Source: Pollution Prevention Program, Department of Natural Resources and Environmental Control. Undated. *Delaware Industries Prevent Pollution.*

Florida

The Naval Aviation Depot

P² Technique: Process Modification, Input Substitution, Inventory Control

Contact Information: M.G. Linn

Naval Aviation Depot
Jacksonville, FL
(904) 772-2457

The depot generates large quantities of daily waste. Its pollution prevention plan (\$19 million installation cost) involves several strategies:

- using non-hazardous materials and processes instead of hazardous ones;
- changing to more efficient and non-hazardous plating and metal deposition processes;
- centralizing control management of hazardous materials; and
- constructing a closed-loop treatment plant.

Results

- About 1.5 million pounds of waste reduction was achieved in the first year.
- Annual savings were about \$5 million, resulting in a total payback period of about 3.5 years.
- Changes also resulted in improved working conditions.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. Pollution Prevention Success Stories.

Georgia

Freudenberg-NOK

P² Technique: Process Modification, Input Substitution, Equipment Modification

Contact Information: Wendy L. McPherson

Georgia Department of Natural Resources
Atlanta, GA 30334-9004
(404) 651-5120

Freudenberg-NOK, an automotive parts manufacturer, successfully used waste reduction teams at its Cleveland, Georgia facility to identify and implement pollution prevention opportunities. The pollution prevention measures implemented included:

- Reducing the significant excess material, or flash, generated at the edge of rubber parts during the molding process each year. This was achieved by reducing the prep weight of seven of the rubber-molded products by about one gram each.
- Reducing VOC emissions by switching from a methanol-based adhesive to a water-based adhesive for the bonding of rubber and metal parts.
- Reducing VOC emissions caused by the presence of methyl ethyl ketone in the dip coating operation. This was achieved by circulating chilled water through coils around the coating bath. This helped to lower the bath temperature, reducing the evaporation rate of the methyl ethyl ketone. Since the facility already had a chilled water system, all that was required was piping installation at a cost of about \$500.

Results

- By lowering the prep weight of seven molded products, flash waste was reduced by about 3.4 tons per year, saving about \$76,000 in raw material costs.
- The substitution to a water-based adhesive reduced methanol consumption at the facility from 240 drums to 24 per year. In addition, annual VOC emissions were reduced by 38 tons, resulting in annual operating savings of \$21,000 per year.
- Modifications of the dip coating bath operation reduced VOC emissions by 13.2 tons per year. This modification also saved \$13,500 per year (72 drums) in methyl ethyl ketone purchases.

Source: Pollution Prevention Assistance Division, Georgia Department of Natural Resources. 1997. *Pollution Prevention Case Studies*.

Gailey Manufacturing

P² Technique: Process Modification, Input Substitution

Contact Information: Wendy L. McPherson

Georgia Department of Natural Resources
Atlanta, GA 30334-9004
(404) 651-5120

Gailey Manufacturing switched from hardwood to plywood in its furniture frame construction process which enabled it to reduce both waste disposal and operating costs. Although the cost of plywood is significantly higher than hardwood per board foot, and the equipment necessary to cut the plywood required a large investment, tests indicated plywood substitution would decrease waste volume and the amount of material purchased.

Results

- A reduction of raw material scrap rate from 40% to 2% was achieved.
- Waste disposal costs decreased to about \$180 annually for a savings of \$4,140 per year.
- Operation costs were reduced by 50%.
- Product life span was extended because plywood assembly is stronger and more durable.

Source: Pollution Prevention Assistance Division, Georgia Department of Natural Resources. 1997. *Pollution Prevention Case Studies*.

Patterson Pump Company

P² Technique: Process Modification, Input Substitution

Contact Information: Wendy L. McPherson

Georgia Department of Natural Resources
Atlanta, GA 30334-9004
(404) 651-5120

Patterson used to degrease exhaust frames by wiping them with an industrial cloth immersed in lacquer thinner. Each time the cloth was immersed, the thinner would become contaminated with dirt and oils. In 1992, Patterson generated 15,632 pounds of lacquer thinner waste and shipped thirty-nine 55-gallon drums off-site for disposal. Disposal costs totaled \$3,900. Patterson replaced the lacquer thinner with a citrus based cleaner. Instead of immersing the cloth, the cleaner is now sprayed directly onto the frame and then wiped clean.

Results

- Generation of lacquer thinner waste decreased by 2,990 pounds (seven drums).
- Disposal costs were reduced by \$3,200.
- Purchase of thinner decreased by 32 drums per year.

Source: Pollution Prevention Assistance Division, Georgia Department of Natural Resources. 1997. *Pollution Prevention Case Studies*.

Idaho

Southern Idaho Solid Waste

P² Technique: Consumer Education

Contact Information: Terry Schultz

Southern Idaho Solid Waste
P.O. Box 159
Burley, ID 83318
(208) 432-9082

Solid waste management costs in the rural west have increased due to the expense of required long haul transportation systems. Southern Idaho Solid Waste has made an attempt to promote individual responsibility for waste generation through an information campaign and a compost bin distribution program. The information campaign is conducted through workshops by public information specialists and Master Gardener volunteers from the Agricultural Extension Service. The compost bins are sold to residents for \$15 each.

Results

- 1,000 bins are sold each year.
- About 94% of residents indicated they continued to use their compost bins after one year.
- 840 pounds of organic material is composted annually.
- Reduced vehicular emissions and gasoline consumption due to the decrease in long haul transportation of solid waste.

Source: National Recycling Coalition. 1996. *Making Source Reduction and Reuse Work in Your Community: A Manual for Local Governments*.

Indiana

Discount Labels, Inc.

P² Technique: Input Substitution, Process and Equipment Modifications

Contact Information: Charles Sullivan

Office of Pollution Prevention and Technical Assistance (OPPTA)
Indiana Department of Environmental Management (IDEM)
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 232-8174

Until 1994, Discount Label's 47 flexographic printing lines used a variety of solvents to keep inks at their required viscosity. Solvents were also used to clean the ink fountains and rollers. In order to reduce the generation of hazardous waste and air pollution, Discount Labels switched to a newly formulated, safer water-based ink. This change required the company's research and development team to design and retrofit every printing line with constant-turn ink fountains and to design and build an automatic ink pot

wash station. In addition, the water-based ink had to be specially formulated for Discount Labels because the standard stock could not work successfully on its unique presses. This new process required press operators to undergo extensive training.

Results

- Total emissions of VOCs and HAPs were reduced by more than 39 tons per year. This reduction allowed the company to become a conditionally exempt generator of hazardous waste instead of a SQG.
- The company now saves about \$22,000 annually on hazardous waste removal.
- The water-based ink process has improved production, worker safety and health, and has eliminated the fire hazards associated with solvents.

Source: OPPTA, IDEM. 1996. *Annual Report on Pollution Prevention in Indiana*.

Best Lock Corporation

P² Technique: Input Substitution, Process and Equipment Modifications

Contact Information: Charles Sullivan

Office of Pollution Prevention and Technical Assistance (OPPTA)
Indiana Department of Environmental Management (IDEM)
P.O. Box 6015
Indianapolis, IN 46206-6015
(317) 232-8174

In 1986, Best Lock, a lock manufacturer, generated more than 20 tons of chlorinated hazardous waste and 47 tons of chlorinated HAPs. In order to reduce this chlorinated waste and air pollution, it embarked on a pollution prevention program that consisted of three major strategies:

- It replaced its chlorinated vapor degreasing operation with parts washers that use an alkaline soap cleaner mixed with water.
- It switched from a solvent-based paint system to an electrostatic, non-hazardous paint system.
- It reviewed engineering specifications and did away with all ODCs and lubricants.

Results

- It eliminated the generation of all chlorinated hazardous waste and air pollution.
- Changes to the chlorinated vapor degreasing operation eliminated employee exposure to perchloroethylene, a possible carcinogen.

Source: OPPTA, IDEM. 1996. *Annual Report on Pollution Prevention in Indiana*.

Holiday Rambler (Monoco Coach)

P² Technique: Input Substitution, Equipment Modernization

Contact Information: Grant Smith

Citizens Action Coalition of Indiana
3951 N. Meridian Street, 3rd Floor
Indianapolis, Indiana 46208
(317) 921-1120/(800) 201-1210

Holiday Rambler, a manufacturer of motor homes and RVs, replaced a highly volatile, toxic "red" adhesive with a non-VOC/non-HAP used in the gluing of RV side panels, storage bays and dashboards. The new equipment for this change cost \$900,000.

Results

- The savings on raw material, air permit costs, employee hazardous waste training, ventilation, insurance, and hazardous waste management were \$265,450 (i.e. 3.4 years payback).
- 131 tons of toxic air emissions were eliminated.
- Product quality improved.
- Worker exposure was reduced.

Source: Citizens Action Coalition of Indiana. August 1997. *Costs and Cost Savings from Clean Manufacturing (Industrial Pollution Prevention)*.

CTS Corporation

P² Technique: Equipment Modernization, Input Substitution

Contact Information: Grant Smith

Citizens Action Coalition of Indiana
3951 N. Meridian Street, 3rd Floor
Indianapolis, Indiana 46208
(317) 921-1120/(800) 201-1210

CTS, a manufacturer of microelectronic and microcircuit components for military, medical, industrial and commercial uses, eliminated the use of CFCs for two degreasing operations. In both operations, a no-clean flux is now used. In one operation, CFCs were replaced by water and new washing equipment. The equipment required for this change cost \$18,000. In the other, CFCs were replaced with no-clean flux reflowed within a nitrogen blanket.

Results

- Savings on material and disposal costs amounted to \$80,000 per year.
- 46% of the plant's CFC emissions were eliminated.

Source: Citizens Action Coalition of Indiana. 1996. *Industrial Pollution Prevention Case Studies in Indiana*.

Maine

Hussey Seating Company

P² Technique: Input Substitution, Equipment Modernization

Contact Information: Dana Peck

Environmental Affairs
Hussey Seating Company
North Berwick, ME 03906
(207) 676-2271

In an effort to improve the work environment at its bleacher manufacturing facility and to achieve standards set by the Clean Air Act, the Hussey Seating Company implemented a pollution prevention plan that would reduce the emission of VOCs and HAPs from its wood finishing operations. To achieve this, an automated UV coating system costing \$320,000 was purchased and installed to replace the polyurethane coating system.

Results

- Annual labor savings amounted to \$280,000.
- Annual material savings amounted to \$55,000.
- The \$200,000 construction of additional storage space was avoided.
- The new system improved product quality and employee health and safety.
- VOC and HAP emissions were reduced from nearly 50 tons per year to 219 pounds per year.

Source: Northeast Waste Management Officials' Association. Undated. *Pollution Prevention Case Study: Wood Furniture Finishing.*

Maryland

Montgomery County

P² Technique: Source Reduction

Contact Information: Joseph M. Keyser

Department of Environmental Protection
101 Monroe Street, Suite 607
Rockville, MD 20815
(301) 217-2361

The County's Ten Year Integrated Solid Waste Plan requires that solid waste be reduced or recycled by 50% by the year 2000. A yard trimmings (18% of solid waste disposal stream) disposal ban was initiated in 1994. The county compost facility could not handle the increasing yard waste, therefore, a source reduction program featuring grasscycling, home composting and mulching was initiated to avoid a \$2.5 million expansion of the facility.

Results

- Almost 50% of the yard waste was reduced at its source within the first two years.
- The number of residents involved in the program increased.
- The \$2.5 million expansion of the compost facility was avoided.
- There was a reduction in county vehicular emissions and gasoline consumption due to the decrease in weekly curbside collections.

Source: National Recycling Coalition. 1996. *Making Source Reduction and Reuse Work in Your Community: A Manual for Local Governments.*

Massachusetts

Crest Foam

P² Technique: Input Substitution, Process Modification

Contact Information: Office of Technical Assistance (OTA)

Executive Office of Environmental Affairs (EOEA), Suite 2109
100 Cambridge Street
Boston, MA 02202
(617) 727-3260

Crest Foam is a manufacturer of flexible polyurethane foam for furniture, cushioning applications for the home, packaging and medical applications. The foam was manufactured via the "One Shot" process which used trichlorofluoromethane (CFC-11), an ozone depleting chemical, as the auxiliary blowing

agent. As a result of regulations prompted by the Montreal Protocol, Crest Foam replaced CFC-11 with methylene chloride, a VOC.

In order to reduce VOC emissions, Crest Foam installed an innovative foam manufacturing process called the "Cardio Process". This process replaced methylene chloride with carbon dioxide (CO₂) as the auxiliary blowing agent. Installing the Cardio Process required a year of planning and \$1.5 million in capital investment.

Results

- The substitution of methylene chloride with CO₂ reduced Crest Foam's VOC and HAP emissions by 190,000 pounds per year. This also meant that Crest Foam was no longer required to report methylene chloride use to the EPA and the Massachusetts Department of Environmental Protection.
- Switching to CO₂ saved \$50,000 per year because CO₂ is three times more efficient than methylene chloride and 80% less expensive.
- The new process allowed Crest Foam to avoid installing costly air emission control equipment or reduce the type and amount of foam product it manufactures.

Source: OTA, EOE, Commonwealth of Massachusetts. March 1997. *Toxics Use Reduction Case Studies (Case Study #45)*.

Ocean Spray Cranberries, Inc.

P² Technique: Process Modification

Contact Information: Jodie Siegel

Toxics Use Reduction Institute (TURI)
University of Massachusetts Lowell
One University Avenue
Lowell, MA 01854

The Ocean Spray facility at Middleboro receives, processes, and packages fresh cranberries and juice concentrates into juice products and concentrate mixes. The facility used chemicals listed under the Toxics Use Reduction Act (TURA) to adjust pH, prevent scale and lime buildup, and protect against corrosion in the cooling water system of its various operations.

Ocean Spray changed its cooling water system by applying Parrot technology to its cooling towers enabling them to use only water, and generate no solid or hazardous waste. The function of this technology is based upon continuously changing electronic frequencies in the cooling fluid, which results in electrical charges that destroy microbes, balance pH, and inhibit precipitation (scaling). Capital costs for the new cooling water system amounted to \$27,300.

Results

- Elimination of TURA listed chemicals in the cooling water system.
- Annual savings amounted to \$10,044 as a result of the elimination of purchase, maintenance, storage, regulatory compliance, and waste management costs for chemicals. The payback period on capital costs was 2 years 7 months.

Source: Cleaner Technology Demonstration Sites and Matching Grants Program. 1997. *Ocean Spray Cranberries, Inc., Middleboro, Massachusetts: Elimination of Cooling Tower Chemical Additives (Technical Report #44)*. TURI, University of Massachusetts Lowell.

Dydee Diaper Service Company

P² Technique: Consumer Education

Contact Information: Office of Technical Assistance

Executive Office of Environmental Affairs, Suite 2109
100 Cambridge Street
Boston, MA 02202
(617) 727-3260

Dydee Diaper Service washes about 200,000 pounds of linen and diapers per week. Violations of its zinc discharge limits were due to the presence of zinc oxide (derived from diaper rash ointment) in the diapers customers brought to the washer. After considering various alternatives (including installation of a new wastewater pretreatment system), Dydee decided to embark on a customer "no zinc" education program. In this program, Dydee purchased zinc oxide-based ointment from its customers for \$1 per container, and sold them zinc-free alternatives at approximately half their retail cost. Dydee spent \$1,000 buying old zinc oxide-based ointment tubes and \$7,000 giving out free samples of zinc-free ointments.

Results

- Dydee estimates that it saved \$250,000 by implementing the consumer "no zinc" program instead of the other alternatives.
- Zinc discharges in wastewater decreased considerably (from up to 4.5 ppm to about 1.0ppm). This resulted in the elimination of zinc discharge limit violations.
- Dydee's public perception improved.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

Beloit Corporation

P² Technique: Input Substitution, Equipment Modification

Contact Information: Office of Technical Assistance (OTA)

Executive Office of Environmental Affairs (EOEA), Suite 2109
100 Cambridge Street
Boston, MA 02202
(617) 727-3260

The Beloit Corporation, which manufactures heavy machinery for paper mills, designs paper mills and factories and rebuilds old machinery, replaced the water-based coolant used in its metalworking operation with a mineral oil-based coolant. The water-based coolant had a short life, high disposal costs, poor lubricity, and caused skin irritation problems for machine operators. The mineral oil-based coolant alleviated all these drawbacks. Equipment costs for this change amounted to \$9,000, and the new coolant cost 47% more than the old one.

Results

- Reduced disposal costs and longer coolant life span have saved Beloit \$18,000 annually.
- Equipment life is now 2 to 2½ times longer after the change.
- Productivity has more than doubled.
- Annual savings of \$61,200 (24%) in equipment purchases have been achieved by the change.
- Employee dermatitis problems have been alleviated.
- Off-site disposal of about 5,600 gallons per year of waste coolant has been averted.

Source: OTA, EOEA, Commonwealth of Massachusetts. April 1997. *Toxics Use Reduction Case Studies (Case Study #18)*.

Michigan

Wolverine Bronze Company

P² Technique: Process and Equipment Modification, In-Process Recycling

Contact Information: Michigan Department of Environmental Quality

Environmental Assistance Division

P.O. Box 30457

Lansing, MI 48909-7957

(800) 662-9278

Like other metal foundries, Wolverine Bronze has experienced an increase in the costs of buying new sand and disposing of used sand. In 1989, the company began the process of installing a low energy sand recycling system after the initial thermal recycling system that had been employed had proved to be ineffective. At the heart of the new system is an "attrition" unit, in which used sand grains rub against each other at high speed. Residual binder and inorganic contaminants are scrubbed from the sand grain surfaces by the abrasion, resulting in sand almost as clean as the virgin product.

Results

- The new low energy system provided big energy costs savings (up to \$1,825 per day).
- Maintenance costs savings were also realized with the new system.
- The amount of new sand purchased per year was reduced.

Source: Environmental Assistance Division, Michigan Department of Environmental Quality. March 1996. *Case Study: Wolverine Bronze Company.*

Lorin Industries

P² Technique: In-Process Recycling, Process Modification, Energy Efficiency

Contact Information: Michigan Department of Environmental Quality

Environmental Assistance Division

P.O. Box 30457

Lansing, MI 48909-7957

(800) 662-9278

Lorin Industries, the world's largest volume job shop coil anodizer of aluminum, has woven waste reduction into its corporate structure. The company has instituted a classic aluminum scrap recycling program in order to avoid landfilling. Millions of pounds of aluminum scrap are sold annually. The wooden skids around which the aluminum coils are wound are reused if possible, rebuilt if necessary and, if beyond repair, chipped for landscaping mulch. Lorin also recycles the large volumes of sulfuric acid, phosphoric acid, and sodium hydroxide used in its anodizing process. Process wastewater is also treated collectively in the company's wastewater treatment system. Lorin uses the lime by-product from a nearby company that manufactures acetylene to adjust the wastewater pH, and has found this to be cheaper than the sodium hydroxide it previously used. The company has also installed a cogeneration system to conserve energy.

Results

- Scrap aluminum disposal costs were reduced.
- Annual savings of \$400,000 in chemical and disposal costs were achieved.
- Neutralizing and recycling process wastewater resulted in reduced water consumption.
- Energy savings from the cogeneration system amounted to about \$540,000 per year (4 years payback).

Source: Environmental Assistance Division, Michigan Department of Environmental Quality. February 1996. *Case Study: Lorin Industries.*

Missouri

National SoyDiesel Development Board

P² Technique: Input Substitution

Contact Information: National SoyDiesel Development Board

1907 Williams Street
Jefferson City, MO 65110-4898
(800) 769-3437

The combustion of diesel fuel in mass transit vehicles generates emissions such as particulate matter, hydrocarbons, carbon monoxide, nitrogen oxides, and sulfur oxides. In 1993, more than 30 transit authorities participated in a program sponsored by the biodiesel industry to evaluate biodiesel as an alternative fuel. Biodiesel is a cleaner-burning fuel made from natural, renewable resources such as soybean and vegetable oils. This program involved the distribution of enough biodiesel fuel to log about 7 million road miles in more than 100 demonstrations involving more than 1,500 vehicles. The demonstration mass transit vehicles used a 20% biodiesel:80% petroleum diesel mixture as fuel.

Results

- A reduction of smoke was recorded (20 to 30 percent in some cases).
- Particulate matter was reduced by 31%, hydrocarbons by 47%, carbon monoxide by 21%, and nitrogen oxides by 3%. Biodiesel contains no sulfur, therefore, sulfur dioxides were also reduced (not quantified).
- The performance of biodiesel in terms of torque, horsepower, and miles per gallon is comparable to that of petroleum diesel, but provides about 2% fewer Btus per gallon.
- Biodiesel appears to provide slightly better lubrication to engine parts than petroleum diesel.
- Biodiesel requires no expensive engine modifications.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

Nevada

Echo Bay/Cove Mine

P² Technique: Input Substitution, In-Process Recycling, Equipment Modification

Contact Information: University of Nevada (Reno)

Nevada Small Business Development Center/032
Business Environmental Program
Reno, NV 89557-0100
(800) 882-3233

The daily operations of the mine generated a large quantity of various hazardous wastes. The greatest volume of waste was halogenated solvents used in parts washing. In order to eliminate future liability costs and to attain the status of SQG under the Resource Conservation and Recovery Act, the mine formed a Corrective Action Team (CAT) to identify waste reduction actions. CAT found a safer replacement solvent that was more expensive (\$11.95/gallon versus \$3.50/gallon for the replaced solvent), and so decided to employ a filter recycling system that would extend its useful life. The filtration equipment and replacement solvent cost \$11,400.

Results

- Elimination of the hazardous solvent wastestream that was being generated at a rate of about 12,000 pounds per year. The non-hazardous replacement solvent wastestream is now less than 1,500 pounds per year.
- Change of status from LQG to Conditionally-Exempt SQG.
- Elimination of 4,500 pounds per year of halogenated lubricant waste by switching to a recyclable, non-halogenated alternative.
- Regulatory requirements and overall environmental liability were reduced.
- Annual savings of \$9,300 meant that the payback for the \$11,400 investment was 14.7 months.
- Annual savings of \$6,600 in disposal costs and \$16,000 in LQG training costs were achieved.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

New Jersey

A New Jersey School District

P² Technique: In-Process Recycling, Input Substitution, Inventory Control

Contact Information: Mary Ann Curran

Risk Reduction Engineering Laboratory, USEPA
Pollution Prevention Research Branch
Cincinnati, OH 45268

Vehicle maintenance and repair, building cleaning and maintenance, grounds keeping, and instructional and specialized programs such as science labs and art classes are some of the activities within school districts that have the potential to generate hazardous waste. An assessment of a New Jersey school district's administration activities and high schools was performed to determine appropriate pollution prevention opportunities. Some of the pollution prevention opportunities included: ordering only the amount of materials that can be used for one year; stocking materials near the point of use; replacing solvent-based paint products with water-based paints and cleaners; and recycling cutting oil used in the industrial arts metal shop.

Results

- Hundreds of empty paint cans that required some form of waste disposal were eliminated.
- A 67% reduction in cleaner solvent wastes was realized.
- Antifreeze waste and 50% of hazardous waste from laboratory experiments were eliminated.
- Annual savings of at least \$3,000 were identified for this school district. Applying these savings to New Jersey's 595 active school districts amounts to annual savings of about \$1.8 million.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

City of Newark

P² Technique: Equipment Modification, Consumer Education, Energy Efficiency

Contact Information: Frank Sudol

City of Newark
920 Broad Street, Rm. 410
Newark, NJ 07102
(201) 733-4356

Since 1987 when its local landfills were closed, the City of Newark's solid waste disposal costs increased from about \$25 per ton to more than \$100 per ton due to the need to transport waste to out-of-state landfills. Source reduction became one of the priorities on Newark's leadership. The goals of the city were to reduce solid waste generation by a minimum of 10%, as well as recycle a minimum of 60% of the municipal solid waste stream. City activities also contributed to air and water pollution. Various strategies were used to conserve resources and to prevent pollution at its source, including:

- Introducing the use of pitometers that search for water leaks within the municipality's infrastructure.
- Replacing less efficient fluorescent, incandescent, and mercury vapor street lights with high pressure sodium lights.
- Educating consumers on the use environmentally friendly alternatives to commonly used household materials such as cleanser, drain cleaners, batteries, paints, and pesticides.
- Educating consumers on the conservation of water by distributing flow restrictors and toilet tank water saving devices.

Results

- Street light changes resulted in savings of \$1.3 million per year in electricity costs and reduced mercury emissions.
- About 20% of the original amount of water used was conserved, which resulted in energy savings at water and sewage treatment plants.
- There was a reduction in the amount of solid waste sent to landfills.
- The city received excellent publicity.

Source: NACCHO, NACo, NPPR, MWMA, and Conference of Mayors. Fall 1995. *Preventing Pollution in our Cities and Counties: A Compendium of Case Studies*.

New York

Emsig Manufacturing Corporation

P² Technique: Input Substitution, In-Process Recycling

Contact Information: Rosita DiCioccio

Pollution Prevention Unit

New York State Department of Environmental Conservation (NYSDEC)

50 Wolf Road

Albany, NY 12233-8010

(518) 457-2553

Emsig is a manufacturer of clothing buttons in Hudson. The buttons are made from unsaturated polyester resin that requires one or two casting processes or a molding operation. The containers, tools, and equipment used in the casting and molding of resin were previously cleaned with acetone because of its ability to easily remove and dissolve the polyester resin.

In 1993, Emsig decided to reduce the generation of acetone 95 percent by substituting it with an aqueous cleaner, Cleaner No.10. Since aqueous cleaner emulsifies rather than dissolves resins, the resins cleaned from Emsig's equipment settled and hardened resulting in plugged piping and pumps. Waste from this process could not be discharged to a sewer due to the styrene content and disposal costs would be too expensive. Emsig's solution was to install a closed-loop ultra-filtration system which separated the resin from the aqueous cleaner, and allowed the cleaner to be continually reused.

Results

- Within the first 8 months of these changes, the need for 140,087 pounds of acetone was eliminated. This amounted to total raw material and disposal cost savings of \$105,748 for acetone. These savings were estimated to rise to \$133,000 after one year.
- The switch to Cleaner No.10 saved \$85,048 over the same period in equipment cleaner purchases.
- The closed-loop ultra-filtration system recovered more than 90 percent of the aqueous cleaner.

Source: Pollution Prevention Unit, NYSDEC. 1996. *1996 Award Winner: NYS Governor's Award for Pollution Prevention.*

HADCO Corporation

P² Technique: Process and Equipment Modifications, Input Substitution, In-Process Recycling

Contact Information: Rosita DiCioccio

Pollution Prevention Unit

New York State Department of Environmental Conservation (NYSDEC)

50 Wolf Road

Albany, NY 12233-8010

(518) 457-2553

HADCO is a large volume manufacturer of dense, fine-line, high-technology printed circuit boards.

HADCO's pollution prevention program included:

- Elimination of hazardous solvents from the masking operation by modifying the coating formulation to include higher solid content.
- Replacing 1,1,1-trichloroethane (TCE) and dichloromethane with an aqueous board cleaner by modifying existing equipment and adding a rinse station. A specialized screen cleaner was purchased which allowed a non-chlorinated cleaner to be used instead of methylene chloride.
- Installation of a sludge dryer for the metal hydroxide residue generated from the treatment of various electroplating wastes.
- Modification of the manufacturing process so that all copper-bearing scrap can be recycled.

Results

- Changing the coating formulation eliminated the use of hazardous solvents in the manufacturing process, and reduced masking solvent emissions by 20 percent. This change also allowed for savings in raw material costs.
- Switching from TCE and dichloromethane to aqueous-based cleaners reduced chlorinated emissions by over 100,000 pounds per year. The generation of chlorinated solvent waste was reduced over 95 percent.
- The sludge dryer reduced the generation of wastewater treatment residue, thereby reducing transportation and reclamation costs and hazards. Cost savings in drying the metal hydroxide residue has produced a payback on the drying equipment of less than 16 months.
- Recycling all copper-bearing scrap eliminated the landfilling of over 100,000 pounds per year of copper bearing waste. This reduced solid waste disposal costs by almost \$4,000 per year.

Source: Pollution Prevention Unit, NYSDEC. 1996. *1996 Award Winner: NYS Governor's Award for Pollution Prevention.*

Hydro-Air Components, Inc.

P² Technique: Process Modifications, In-Process Recycling

Contact Information: Rosita DiCioccio

Pollution Prevention Unit

New York State Department of Environmental Conservation (NYSDEC)

50 Wolf Road

Albany, NY 12233-8010

(518) 457-2553

Hydro-Air is a manufacturer of hydronic heating equipment, including cabinet connectors, custom enclosures, and radiant wall panels used in schools, hospitals and office buildings. It previously used solvents in its painting operations, which required it to apply for NYSDEC permits. All the dry paint residue and filters were disposed in a landfill. The waste solvents and waste paint were disposed of through off-site incineration.

In order to reduce VOC emissions and all hazardous waste generation, Hydro-Air switched to a powder coating process. Programs to recycle scrap metal and to train employees in hazardous spill prevention were also initiated.

Results

- 12 tons of VOC emissions were eliminated. This resulted in the elimination of possible health risks to employees with long term exposure to solvents.
- Solid hazardous waste was reduced by 4,000 pounds per year and this saved the company \$4,000 annually in disposal costs. Liquid hazardous waste was reduced by almost 1,000 gallons per year and this saved the company nearly \$3,000 annually in disposal costs.
- Paperwork associated with the handling and disposal of solvents and solvent-based materials was eliminated.
- The powder coating system recycled up to 85 percent of the over-spray powder, resulting in a reduction of the amount of raw material purchased.

Source: Pollution Prevention Unit, NYSDEC. 1997. *1997 Award Winner: NYS Governor's Award for Pollution Prevention.*

The Village of LeRoy

P² Technique: Source Reduction, Inventory Control

Contact Information: The Administrator

The Village of LeRoy

(716) 768-2527

The village depends on Lake LeRoy and Lake LeGrange for its water supply. For a number of years, the village experienced serious taste, odor, and color problems with its water supply. The installation of a filtration system alleviated these problems, but only temporarily. The source of the water quality problems was later found to be algal blooms and weed growth resulting from nutrient runoff into the lakes from nearby farms. Farmers in the area established a committee to improve water quality that developed programs to reduce fertilizer use and to control nutrient runoff.

Results

- There was a reduction in the use of fertilizers in the area. This resulted in savings amounting to \$9,000 in fertilizer purchases each year.
- Nitrate contamination from the use of fertilizers was reduced.
- Additional capital improvements necessary to comply with the safe drinking water requirements were avoided.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

North Carolina

Albemarle Regional Solid Waste Management Authority (ARSWMA)

P² Technique: Inventory Control, Consumer Education

Contact Information: Jerry Parks

ARSWMA
Rt. 1, Box 152C
Belvidere, NC 27919
(919) 297-3300

As part of North Carolina's per capita solid waste reduction goal of 40% by the year 2001, ARSWMA has implemented in-house source reduction programs for schools and government offices. These programs include:

- Changing from paper towels to cloth roll towels in kitchens.
- Making two-sided paper copies.
- Routing inter-office mail in reusable envelopes.

Results

- The annual diversion of solid waste from the landfill was at least 5 tons.
- Annual savings of solid waste management costs amounted to \$4,000.

Source: National Recycling Coalition. 1996. *Making Source Reduction and Reuse Work in Your Community: A Manual for Local Governments*.

Oklahoma

Amoco Production Company

P² Technique: Inventory Control

Contact Information: Oklahoma Department of Environmental Quality

Pollution Prevention Program
1000 N.E. 10th Street
Oklahoma City, OK 73117-1212
(800) 869-1400

Amoco is a major operator in the exploration and production of natural gas in the eastern Oklahoma region. It operates 9 separate compression facilities, and the use of chemicals in its operations is

significant and necessary. Management of Amoco's large inventory of hazardous chemicals and the resulting waste streams required changes in the existing system, these included:

- Creation of a database of all chemicals purchased and used.
- The development of a new policy for procurement of chemicals.
- Improved tracking of materials.

Results

- 32 unnecessary chemicals and consumer products were eliminated.
- The use of alternative packaging eliminated 50 percent of chemical deliveries.
- State and federal regulatory compliance improved.
- 90 percent of the listed hazardous wastes from 1995 to 1996 were eliminated.
- Worker health and safety improved.

Source: Pollution Prevention Program, ODEQ. August 1997. *Pollution Prevention in Oklahoma: Amoco Production Company.*

Vance Air Force Base (VAFB)

P² Technique: Input Substitution, Inventory Control, Process Modifications

Contact Information: Oklahoma Department of Environmental Quality

Pollution Prevention Program
1000 N.E. 10th Street
Oklahoma City, OK 73117-1212
(800) 869-1400

VAFB is located on 4,934 acres with 142 buildings, and has approximately 2,450 employees. Part of the base mission involves aircraft maintenance and civil engineering activities. VAFB implemented a pollution prevention program in 1990 to achieve compliance with state and federal environmental regulations. The pollution prevention program targeted the following areas: raw material procurement; materials handling and management; evaluation of substitute products; evaluation of new technologies and techniques; process modifications; and employee training.

Results

- There was a 71% (53 tons) reduction in hazardous waste generation, mainly as a result of the installation of a geodesic dome on an above ground fuel storage tank.
- 67% (8 tons) of ODCs were eliminated.
- Pesticide use was reduced by 29%.
- There was an 88% (63 tons) reduction in hazardous air emissions (SO_x, NO_x, CO₂, VOCs).
- Solid waste generation was reduced by 66% (1900 tons).

Source: Pollution Prevention Program, Customer Services Division, ODEQ. August 1997. *Pollution Prevention in Oklahoma: Vance Air Force Base (VAFB).*

VAC Corporation

P² Technique: Process and Equipment Modification

Contact Information: Oklahoma Department of Environmental Quality (ODEQ)

Pollution Prevention Program
1000 N.E. 10th Street
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(800) 869-1400

VAC is a manufacturer and major worldwide supplier of disk drive components. In order to eliminate the use of Freon TMS (an ODC) as the chosen cleaner, VAC implemented process and equipment modifications so that two aqueous cleaning lines could be installed. The first line involved an ultrasonic wash and rinse before drying, and the second one involved the use of a conveyor to move parts through pre-soap, wash, rinse, virgin deionized water rinse and drying cycles.

Results

- HFC emissions were eliminated (from 200,000 pounds per year in 1992 to 0 in 1996).
- Wastewater from the aqueous cleaning lines can now be discharged to POTWs.
- Waste management costs associated with wastewater discharge were eliminated.
- Hazardous material handling and disposal cost savings amounted to \$20,000 per week. In addition, there was no loss of productivity or product quality.

Source: Pollution Prevention Program, Customer Services Division, ODEQ. August 1997. *Pollution Prevention in Oklahoma: VAC Corporation.*

Pennsylvania

Leff-Marvins Cleaners

P² Technique: Equipment Modernization, In-Process Recycling

Contact Information: Pennsylvania Department of Environmental Resources

P.O. Box 8472

Harrisburg, PA 17105-8472

(717) 787-7382

Perchloroethylene (PERC), a potential carcinogen, is used in the dry cleaning industry as a cleaning solvent. In response to the Clean Air Act Amendments of 1990, Leff-Marvins Cleaners decided to replace all old machines with new equipment that could condense, distill, filter, and recycle the PERC within a self-contained unit. This new equipment cost \$81,400.

Results

- PERC purchases dropped (80%) from 200 gallons/month to less than 40 gallons/month.
- Waste PERC and lint disposal volumes dropped (75%) from 1,600 gallons to 420 gallons.
- Hazardous waste filters requiring disposal were reduced from 24 to 4 per year.
- Net annual savings of about \$17,000 due to equipment changes were realized.
- Environmental and hazardous material savings amounted to \$1,500 per month.
- Payback of new equipment cost would be achieved in 4 years through reduced PERC purchases, waste disposal savings, and fewer returns of clothing for recleaning because the new equipment cleaned better than the old machines.
- Lower maintenance costs for the new equipment were realized.
- Employee safety improved.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories.*

South Carolina

Crown Cork & Seal Company, Inc.

P² Technique: Equipment and Process Modification

Contact Information: L. Douglas Dobson

Executive Director

Institute of Public Affairs

University of South Carolina

Columbia, SC 29208

(803) 777-8157

Crown Cork & Seal manufactures metal and plastic containers, bottle caps, and aluminum and plastic closures. It also makes filling, packaging, and handling machinery. The manufacturing process at its Spartanburg, South Carolina facility involves the coating and decorating of tinplated steel using a variety of coatings, inks, and solvents that are, or contain, VOCs.

In order to achieve source reduction of VOCs and other hazardous wastes, the Spartanburg facility made four changes to its manufacturing process:

- At a cost exceeding \$2.1 million, the facility installed a regenerative incinerator in which VOCs flowing through the system provide the bulk of the heat through their own combustion. This new incinerator significantly reduced the consumption of natural by approximately 80 percent over the previous incineration system.
- The facility installed an EPIC dampening system on its three lithographic printing presses, including two units on each press line at a cost exceeding \$240,000.
- At a cost exceeding \$260,000, an ultraviolet curing system was installed to cure the inks and vanishes used for the printing on the metal sheets.
- The Spartanburg facility also installed the Anilox coating application system at a cost of \$100,000.

Results

- The regenerative incinerator improved capture efficiency from 60 percent to 85 percent, and destructive efficiency from 90 percent to 97 percent. The airflow through the ovens also improved, providing better run efficiencies in the coating process that subsequently led to an 18 percent increase in productivity. Reductions in natural gas consumption amounted to \$250,000. The new incinerator's increased capture efficiency improved worker health and safety.
- The EPIC dampening system improved print quality, reduced ink consumption 25 percent, and eliminated the need for washing cloth-covered rubber rolls. The reduction in ink consumption helped reduce the volume of VOCs generated at the facility and increased the productivity of the lithographic presses by 10 percent. The elimination of washing cloth covers also eliminated the main source of BOD contaminants discharged into the sanitary sewer. This new system also qualified the facility for semi-annual monitoring instead of the previous quarterly monitoring.
- The UV curing system reduced annual natural gas consumption by 13 percent amounting to annual savings of \$15,000. The new system also eliminated VOC emissions in the lithography press line.
- The Anilox coating application system resulted in reduced coating usage amounting to annual cost savings in excess of \$140,000. This new system has also increased control of the uniform filmweight application of coatings on sheets of tinplate, thereby reducing VOC emissions by about 7.5 percent. The improved quality of the coating application also reduced set-up time on subsequent operations.

Source: Hans VanderKnyff. *P₂SC: More South Carolina Companies Leading in P₂. (A Crowning Touch in Pollution Prevention)*; p.8, Spring 1998. Hazardous Waste Management Research Fund, SC.

South Dakota

Bootstraps Program

P² Technique: Inventory Control, Improved Management Practices

Contact Information: U.S. Department of Agriculture

Natural Resources Conservation Service

White River, SD 57579-0709

(605) 259-3252

Pollution in the cattle raising industry involves any activity that destroys the ecosystem, hinders a ranch's ability to support cattle, or causes the ranch to operate inefficiently. The main resources on a cattle ranch are grass and water, therefore, any activities that protect the land and water resources may be considered pollution prevention activities. In Bootstraps, these activities include vegetation growth, erosion control, surface water management, good recordkeeping on all aspects, long-range planning, and land management practices that improve/maintain soil and water quality. Success was generally measured by how many cattle a rancher can produce per acre of land, and the weight of the cattle sold.

Results

- Reduced runoff and erosion resulted in decreased non-point source pollution.
- Ranch profits increased.
- Healthier and larger cattle herds were achieved.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

Tennessee

Power Tool Manufacturer

P² Technique: Input Substitution, Process Modification, In-Process Recycling

Contact Information: Department of Environment and Conservation

Knoxville, Tennessee

This power tool company processes raw materials into power tool components by stamping, machining, cleaning, oxide coating, and painting. Its pollution prevention program involved:

- Changing to water-based paints to eliminate the annual purchase, use and disposal of thirty-six 55-gallon drums of paint thinner used to clean spray painting equipment.
- Cleaning parts in an existing water-based cleaning system to eliminate the annual purchase, use, and disposal of twenty 55-gallon drums of petroleum solvent.
- Switching to a black oxide coating bath that did not contain chromates.
- Identification and elimination of lead sources to reduce hazardous heavy metals from sludge, and the reduction of annual sludge generation by eight 55-gallon drums.
- Changing from manual to automatic paint spraying to reduce overspraying and annual dried paint waste by 50 percent or ten 55-gallon drums.
- Using only deionized water in phosphate baths to reduce annual phosphate sludge by 30 percent or nine 55-gallon drums.
- Developing a system to recycle cutting oil for reuse to reduce annual waste oil by 80 percent or 24,000 gallons.

Results

- Hazardous waste decreased 35,000 pounds annually.
- Annual non-hazardous solid waste decreased 20,000 pounds.
- Disposal costs decreased \$23,000 annually.
- Raw material costs decreased \$7,000 annually.
- Annual labor costs decreased \$10,000.
- Annual material recovery savings increased \$6,000.

Source: University of Tennessee, Tennessee Department of Environment and Conservation, and Tennessee Valley Authority. 1994. *Case Histories of Cost Saving Through Waste Reduction by Small Industries in Tennessee (TVA 14: Power Tools)*.

Helicopter Service and Repair

P² Technique: Input Substitution, In-Process Recycling

Contact Information: Department of Environment and Conservation
Knoxville, Tennessee

A company involved in helicopter service and repair developed a pollution prevention program to reduce the hazardous wastes created by its various operations, including oil changes, complete engine tear downs, stripping and painting. This program involved:

- Installation of a system to filter dirt, grease, and carbon from 330 gallons of degreasing solvent annually. The solvent costs \$5,470, including disposal.
- Reducing the 175 gallons per month of wastewater after paint stripping by using on-off spray nozzles on hoses.
- Developing a system to recycle paint stripping wastewater and reusing it for initial rinses, using fresh water only for the final rinse.
- Evaluate alkaline and biodegradable cleaners as substitutes for phenol and methylene chloride cleaners.

Results

- The degreasing solvent filter system doubled the solvent life and saved \$4,500 in solvent purchase and disposal costs.
- Hazardous solvent waste was reduced 7,000 pounds annually.
- The use of on-off spray nozzles and recycling paint stripping wastewater helped to qualify the company as a SQG.

Source: University of Tennessee, Tennessee Department of Environment and Conservation, and Tennessee Valley Authority. 1994. *Case Histories of Cost Saving Through Waste Reduction by Small Industries in Tennessee (TVA 34: Aircraft Repair)*.

A Bicycle Seat Manufacturer

P² Technique: Input Substitution, In-Process Recycling

Contact Information: Department of Environment and Conservation
Knoxville, Tennessee

The manufacture of bicycle seats involves metal forming, electrostatic spray painting, metal cleaning, and stripping operations. The manufacturer's pollution prevention program:

- Reduced water consumption, increased residence and settling in the 3-lagoon treatment system, and reduced the lagoon system maintenance costs.
- Used only powder spraying or changed from solvent-based to water-based paint to reduce hazardous solvent waste and atmospheric emissions of VOCs. Installed a system that recovers and recycles 95% of the solvent if solvent-based painting continues.
- Reduced steel scrap from its source.

Results

- Recirculating cooling water saved 20,000 gallons daily.
- Using only powder painting reduced VOC emissions by 75,000 tons annually and saved \$15,000 annually.
- Hazardous waste was reduced 30,000 pounds annually.
- Disposal cost savings amounted to \$4,000 annually.

Source: University of Tennessee, Tennessee Department of Environment and Conservation, and Tennessee Valley Authority. 1994. *Case Histories of Cost Saving Through Waste Reduction by Small Industries in Tennessee (TVA 33: Bicycle Seats)*.

Texas

SuperShuttle Dallas

P² Technique: Input Substitution, Energy Efficiency

Contact Information: Ken A. Zarker

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SuperShuttle serves both airports in the Dallas-Fort Worth metroplex 24 hours a day. The company has a fleet of 80 dodge vans that travel 3,000 to 4,000 miles per week. The fleet averages one million miles per month. SuperShuttle converted its fleet of vans to clean burning propane fuel to reduce gasoline emissions.

Results

- Using propane instead of gasoline cut carbon monoxide emissions by 93 percent, nitrogen oxide emissions by 57 percent, and hydrocarbons by 30 percent.

Source: Office of Pollution Prevention and Recycling, TNRCC. January 1997. *Pollution Prevention & Conservation: P2 Case Studies (SuperShuttle Dallas)*. <http://p2.utep.edu/sshuttl193.htm>.

Nucor Steel

P² Technique: Input Substitution

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Nucor Steel manufactures low carbon and high strength low alloy structural steel. Various types of hydraulic equipment are used in this manufacturing process. Nucor previously used ethylene glycol, a toxic chemical, as a hydraulic fluid in the operation of the equipment. In order to avoid environmental contamination associated with the use of ethylene glycol, Nucor switched to a non-hazardous water glycol primarily composed of diethylene glycol.

Results

- The use of 200,000 pounds per year of hazardous ethylene glycol was eliminated.
- Economic savings resulting from the switch to diethylene glycol were minimal since it cost approximately same as ethylene glycol.

Source: Office of Pollution Prevention and Recycling, TNRCC. January 1997. *Pollution Prevention & Conservation: P2 Case Studies (Nucor Steel)*. [http://p2.utep.edu \(nucostl193.htm\)](http://p2.utep.edu/nucostl193.htm).

Chem-Pruf Door Company

P² Technique: In-Process Recycling, Improved Management Practices

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(512) 239-3144

Chem-Pruf Door manufactures fiberglass reinforced plastic doors, frames, windows and industrial louvers. It has implemented a strategy to reduce all wastes and chemical releases from its operations. A significant amount of the non-hazardous waste it produced was sent to the landfill. Chem-Pruf Door developed innovative processes to recycle and reuse all non-hazardous fiberglass reinforced plastic wastes. This required the purchasing of a crushing machine, a slitter machine and dust collection equipment. Proper mixing and batch sizing was emphasized to minimize waste generation. Any excess resin generated during mixing and molding was collected in containers. Vacuum systems collected dust from all grinding and cutting tools. Dust that accumulated on the floors was collected daily and not allowed to contaminate other materials. Oversized scraps were crushed to smaller sizes. All these wastes were then converted to quality feedstocks for reuse.

Results

- Non-hazardous waste previously disposed of in landfills was reduced from over 100,000 pounds to less than 20,000 pounds per year.
- 74 percent of previous waste materials have been converted into finished products.
- The fiberglass reinforced plastic utilization rate increased to over 90 percent.
- Material cost savings off-set daily system operations.

Source: Office of Pollution Prevention and Recycling, TNRCC. January 1997. *Pollution Prevention & Conservation: P2 Case Studies (Chem-Pruf Door Company)*. [http://p2.utep.edu \(chmprf293.htm\)](http://p2.utep.edu/chmprf293.htm).

3M Company

P² Technique: In-Process Recycling

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3M uses hydraulic fluid in its injection molding machines. In order to conserve hydraulic fluid and reduce the amount disposed, 3M purchased a filtration cart from Roil Gard at a cost of \$1,200.

Results

- About 500 gallons of hydraulic fluid that was previously disposed was recycled and reused at the 3M plant. Estimated hydraulic fluid purchase and disposal cost savings amounted to \$2,000 annually.

Source: Office of Pollution Prevention and Recycling, TNRCC. January 1997. *Pollution Prevention & Conservation: P2 Case Studies (3M Company)*. <http://p2.utep.edu/3m593.htm>.

Dickson Weatherproof Nail/CDC Coatings

P² Technique: In-Process Recycling, Input Substitution

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Dickson Weatherproof Nail/CDC Coatings
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Currently, zinc is precipitated out of wastewater from the galvanizing department and released to the environment when it is land-filled as a component of sludge. Some zinc is also released through a permitted outfall. Trace amounts of lead, found as a contaminant of zinc, are also released in both sources.

In order to comply with the discharge permit and reduce environmental impact, improvements were made in the efficiency of the galvanizing process through the use of proprietary chemicals and a purer grade of zinc. This reduced the concentration of both lead and zinc in the wastewater and hence in the sludge. In a process integral to galvanizing, about 20,000 gallons per day of fresh water were used to pump a slurry. It was found that fresh water was not needed for this purpose, so a totally enclosed system was constructed by rerouting existing pipe and reallocating existing tank storage.

Further reductions in the wastewater flow were realized by using treated wastewater in non-critical applications, such as preliminary rinses, solution make-up in galvanizing, and polymer and caustic dilution in the wastewater treatment system.

Results

- Through the use of treated wastewater in non-critical applications and using a totally enclosed system for pumping the slurry, wastewater flow was reduced by 30,000-35,000 gallons per day.
- A reduction in the wastewater flow resulted in compliance with the company's permitted wastewater discharge. The lower flow rates also improved the performance of the wastewater treatment system, thus reducing the amount of zinc and lead released through the outfall.

- Improved zinc use efficiency in the galvanizing operation not only reduced zinc and lead concentrations in the wastewater but also in the sludge. The improvements lead to a reduction of about 12,000-15,000 pounds per year of lead and zinc released to the environment, primarily in the sludge.
- Cost savings were realized primarily from the improvement in zinc use efficiency. Estimates are in the range of \$42,000 per year.

Source: Office of Pollution Prevention and Recycling, TNRCC. January 1998. *Dickson Weatherproof Nail/CDC Coatings*.

Betz Laboratories, Inc.

P² Technique: Input Substitution

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Betz has a maintenance workshop that routinely degreases equipment that is being repaired. Rather than using a hazardous solvent to clean parts, which generates hazardous waste, Betz switched to an aqueous degreaser. The resulting wastewater is now acceptable for treatment in a POTW.

Results

- A drum of aqueous degreaser costs about \$100 less than a drum of recycled solvent degreaser.
- About 400 gallons per year of hazardous cleaning solvent wastes have been eliminated.

Source: Office of Pollution Prevention and Recycling, TNRCC. March 1996. *Pollution Prevention Ideas from Texas Industries: A Case Study Compendium*.

Vermont

Ethan Allen

P² Technique: Input Substitution, Equipment Modification

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Ethan Allen, a furniture manufacturer and one of the largest air polluters in Vermont, decided to improve its image and comply with Clean Air Act standards for wood furniture. In an effort to reduce VOC emissions, a switch to nitrocellulose sealer and lacquer with higher solid content was made. This, however, meant that the sealer and lacquer had to be heated to reduce their viscosity so that they could continue to be applied by spray gun. The spray gun cap, nozzle, and tip also had to be modified to accommodate this change.

Results

- Reportable emissions and material usage were reduced by about 46% with the new lacquer application.
- The new system required one lacquer application. This allowed some manpower at the lacquer application stage to be transferred to other positions, created more space for the finishing department, and reduced maintenance requirements and the amount of solvent cleaner required.
- Worker health and safety conditions were improved.

- The product quality improved.
- Labor savings amounted to \$175,000 per year.

Source: NEWMOA and NESCAUM. 1996. *Pollution Prevention Case Study: Wood Furniture Finishing*.

Virginia

Washington Metropolitan Area Transit Authority (WMATA)

P² Technique: Process and Equipment Modification, Improved Management Practices

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Bus servicing and maintenance generates large amounts of oily wastes and wastewater. WMATA has implemented some pollution prevention measures to reduce the generation of this waste at its maintenance facility. Some of these measures included:

- Reducing fuel and oil spills to the pavement and surrounding soil.
- Increasing environmental awareness through training, and reviewing maintenance/repair techniques.
- Cleaning the oil/water separators of the excess sludge to eliminate the source of leaching metals and oils.
- Discontinuing the use of detergent in engine wash water and replacing the engine wash system with a medium pressure steam cleaner to eliminate dissolving small quantities of the metal substrate from the bus engine
- Purchasing an antifreeze reclamation unit

Results

- There was an immediate and significant reduction in the waste generated at the WMATA maintenance facility.
- The number of Notices of Violation decreased at the facility.

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

Wisconsin

Parker Pen USA, Ltd

P² Technique: Process Modification

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TCE is used as a solvent in manufacturing refillable writing instruments. In order to reduce hazardous TCE vapor production: TCE volatilization was reduced by turning down the heat input to the boiling

sumps, TCE lifetimes in the degreasers was prolonged by reducing upstream contaminants, and the distillation/recovery of used TCE was improved. The capital cost for these procedures was \$14,500.

Results

- Within 6 months, monthly usage of TCE dropped 40% and annual usage dropped 54%.
- The waste reduction of 36,000 pounds per year amounted to savings of \$23,000 (7.5 months payback of capital cost).

Source: Office of Pollution Prevention and Toxics, USEPA. April 1996. *Pollution Prevention Success Stories*.

Packaging Corporation of America

P² Technique: Input Substitution

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Wisconsin Department of Natural Resources (DNR)
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Packaging Corporation is a paper manufacturer. Until 1995, its manufacturing process used a rewetting agent and a cleaning product that contained nonylphenol (NP) and nonylphenol ethoxylate (NPE). Even though NP and NPE were not regulated, they were considered toxic chemicals because they are thought to affect reproductive organs by stimulating hormonal activity. Packaging Corporation's Tomahawk Mill facility switched to an alternative rewetting agent that contained no NP or NPE at a cost of \$25,000 per year. It also convinced the manufacturer of its cleaning product to reformulate the product and reduce its NP and NPE content.

Results

- The use of NP and NPE at the Tomahawk Mill facility was reduced 255,700 pounds per year after the change to an alternative rewetting agent. The reformulation of the cleaning product further reduced NP and NPE use by 580 pounds per year, for a total reduction of 256,280 pounds per year (99.9% reduction).

Source: Packaging Corporation of America. June 19, 1995. *Inter Office Memorandum: Reduction of Nonylphenol and Nonylphenol Ethoxylate (NP/NPE)*.

International P2 Case Studies

Australia

Apcel Mill

P² Technique: Process Modification, In-Process Recycling

Contact information: John Trafford

Environmental and Development Chemist
Kimberly-Clark Australia, Apcel Mill
Millicent, South Australia 5280

In order to achieve chlorine-free bleaching in its pulping process, Apcel changed to a Magnefite pulping process. This process uses sulfite pulp which has an unbleached brightness of 55% compared to the 30% of the previously used Kraft pulp. This allows sulfite pulp to be bleached to levels of market satisfaction, without use of chlorine or chlorine compounds.

The capital cost (US\$ 113 million) of an installed and operating Magnefite mill is about two-thirds of a Kraft mill. The Magnefite process also has the added advantage of allowing chemical recovery and recycling.

Results

- The Magnefite process helped Apcel meet or exceed the community expectations for effluent discharges to the adjacent Lake Bonney. Waste generation measured by biological oxygen demand reduced by 181 kg/ADt, from 188 kg/ADt to 7 kg/ADt. This reduction meant that the acute and chronic toxicity of the effluent and solid waste disposal was reduced significantly.
- Odorous air emissions from the pulp cooking process were reduced.
- The use of chlorine or chlorine compounds to bleach pulp was eliminated.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Magnefite Pulping Process for Chlorine-free Bleaching*. (www.unepie.org/icpic/icpic.html#technical).

Bolivia

Cerveceria Boliviana Nacional S.A.

P² Techniques: In-Process Recycling, Water Conservation, Equipment and Process Modification,

Contact Information: Environmental Pollution Prevention Project

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Cerveceria Boliviana Nacional S.A. (CBN) is the largest brewing company in Bolivia. It operates three brewing plants, in La Paz, Oruro and Santa Cruz. The P2 assessment conducted in 1997 by EP3 focused only on CBN's La Paz brewery and malt house. This facility has an annual production of 680,000 hectoliters and expects to increase its output by 50 percent in the next few years.

The collaboration between the EP3 team and CBN's staff led to the identification of seventeen P2 opportunities.

Costs and Benefits/Savings of the P2 Opportunities

P2 Opportunity	P2 Recommendation	Benefits	Cost to Implement	Financial Savings
#1	Water conservation in barley washing and steeping operations	• Lowers annual water consumption by 27,500 m³ • Lowers the plant's effluent flow	• \$2,000 for 2 water meters • Additional implementation costs should be moderate	• \$32,500/year in water savings • Effluent disposal savings
#2	Water conservation in the bottle washer	• Lowers annual water consumption by 14,700 m³ • Lowers the plant's effluent flow • Reduces annual natural gas consumption by 2,240 mscf	Moderate	• \$17,400/year in water savings • \$3,800/year in gas savings • Effluent disposal savings
#3	Reuse the bottle washer effluent in the crate washer	• Lowers annual water consumption by 6,240 m³ • Lowers the plant's effluent flow • Reduces the annual natural gas consumption by 353 mscf	Moderate	• \$7,400/year in water savings • \$600/year in gas savings • Effluent disposal savings
#4	Use the bottle washer's effluent to pre-wash the dirty bottles	• Reduces NaOH consumption • Reduces the accumulation of sludge in the washer's caustic tanks	Moderate	• NaOH savings were not quantified during the P2 assessment
#5	Improve the efficiency of the sand filters' backwash operations	• Lowers annual water consumption by 9,310 m³ • Lowers the plant's effluent flow	• \$1,000 for a water or flow meter • Additional implementation costs should be moderate	• \$11,000/year in water savings • Effluent disposal savings
#6	Water conservation measures for the CIP units	• Lowers annual water consumption by 540 m³ • Lowers the plant's effluent flow	Minimal	• \$600/year in water savings • Effluent disposal savings
#7	Equip water hoses with nozzles to conserve water in cleaning operations	• Lowers the plant's water consumption and wastewater generation	• \$170 - \$240 per trigger nozzle • \$10 - \$20 per flow restrictor nozzle	• Water savings could not be quantified during the P2 assessment • Effluent disposal savings
#8	Segregate the effluent from the beer filter backwash operations	• Lowers the annual SS discharge by 200,000 kgs • Lowers the BOD load and the plant's effluent	• Moderate to high • Requires the removal of high strength wastes via tanker trucks	• Effluent disposal savings
#9	Segregate the weekly discharge of hot trub	• Lowers the annual SS discharge by 27,300 kgs • Lowers the annual BOD discharge by 17,200 kgs	• Moderate • Requires the removal of high strength wastes via tanker trucks	• Effluent disposal savings
#10	Segregate the beer that is spilled at the filling and capping station	• Lowers the annual BOD discharge by 10,600 kgs	• Moderate • May require the removal of high strength wastes via tanker trucks	• Effluent disposal savings
#11	Eliminate the regular discharge of hot trub from the whirlpool	• Lowers the annual SS discharge by 4,100 kgs • Lowers the annual BOD discharge by 2,600 kgs	Minimal	• Effluent disposal savings
#12	Reduce the spent grain retained in the mash filter troughs	• Lowers the annual SS discharge by 1,900 kgs • Lowers the BOD of the effluent	Minimal	• Effluent disposal savings

#13	Recover and reuse the formulated belt lubricant	• Lowers the annual purchase of lubricant by 8,100 kgs • Lowers the BOD/COD of the effluent	• Moderate to high	• \$35,000/year in belt lubricant savings
#14	Reduce the drag-out of caustic solution in the bottle washers	• reduces the annual discharge of NaOH by 9,800 kgs	• Moderate to high	• \$7,500/year in NaOH savings
#15	Reduce the discharge of spent caustic cleaning solutions from the CIP units	• Reduces the annual discharge of NaOH by 7,800 kgs	• Moderate	• \$6,000/year in NaOH savings
#16	Collect and reuse the caustic solution which drains from the recovered labels	• Reduces the annual discharge of NaOH by 3,100 kgs	• About \$100 used for the purchase of a hand pump	• \$2,400/year in NaOH savings
#17	Improve the air intake of the compressors	• Reduce the annual energy consumption of the compressors by 36,600 kWh	• Moderate to high	• \$1,700/year in energy savings
Total Quantified Savings				\$157,000/year

Source: Hagler-Bailly Services, Inc.. 1998. *Pollution Prevention Diagnostic Assessment: Cerveceria Boliviana Nacional S.A., La Paz, Bolivia (Executive Summary).*

Chile

Hilados y Tejidos Garib S.A.

P² Technique: In-Process Recycling, Process Modification

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Hilados y Tejidos Garib S.A.

Rodrigo de Araya No.951

Macul Santiago

Chile

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Hilados y Tejidos Garib S.A. (Hitega) is an integrated textile mill producing dyed yarn and fabric with an average content of 65% polyester and 35% rayon. It employs 270 people, and in 1993, produced 1,134,059 kg of dyed material, and an additional 1,227,974 kg of fabric that was finished but not dyed.

The textile dyeing process used at the Hitega textile mill in Chile involves numerous water changes, and several additions of dyes, bleaches and other chemicals. As part of the Environmental Pollution Prevention Project (EP3) sponsored by the US Agency for International Development, a cleaner production assessment was carried out at the facility by an expert in textile dyeing and a pollution prevention. The assessment identified eight opportunities which would reduce: water use, chemical use, energy use, emissions, and suspended solids concentration in wastewater.

Well water is softened to a hardness of 3-5 ppm, and is then used for most factory processes. During the cone-dyeing operation, the dye bath is cooled by passing soft water through the jacket of the dye tank. Non-contact cooling water is also used to cool the dye bath recirculating pump packing gland. Recycling these two streams of water can be accomplished by sending this non contact cooling water back to the soft water pool, which receives the cooling water from facility jet dryers.

The air conditioner system used in the spinning and weaving rooms also uses soft water evaporation for cooling. The water is currently taken from the softeners serving the dye room, but 50 per cent of this is lost through evaporation, and the rest is dumped into the sewer system. This has caused water shortages in

the dye room. New softeners are being installed to produce water solely for the air conditioner system, which will recycle the non-evaporation water back to the new system.

During the washing, regeneration and rinsing processes in the dye room, the wash time is currently excessive, and the point at which softeners are regenerated is chosen on the basis of time since the last regeneration. This results in a loss of soft water. A digital system would enable the rinsing and service hardness end points to be determined, allowing operators to judge more accurately the exact end point for the wash period and the maximal supply capacity of each softener. Rinse waters can also be recycled from the bleaching process, by installing a tank to store the water from one batch and using it for the one that follows.

Heat transfer losses caused by leaking steam traps currently amount to around 10% of energy costs. Leaking steam traps not only waste energy, but also result in inefficient dye bath heating, and damage to steam lines, valves, fittings, and other equipment. Workers should be trained in the operation of steam trap testing equipment, and a preventive plan for the maintenance of steam traps should be developed. Installation of a digital monitoring system allowed the combustion efficiency of the oil-fired boiler to be monitored whenever parameters change such as when a new lot of oil is received. This change resulted in reductions in fuel use and emissions of particulate matter.

Screens installed in dye room drains reduce suspended solids in effluent. If the plant needs to install an industrial wastewater treatment system in the future, any decrease in current loading will allow a reduction in the initial investment and running costs of such treatment plant.

Results

• The implementation of these suggestions will result in water, energy and chemical conservation, reduced emissions and solids in effluent. The costs and savings of three of these suggestions were quantified:

Operation	Cost (US\$)	Saving (US\$/year)	Payback period
• Recycling of dye cooling water	750	400	23 months
• Recycling of air conditioning system water	6,700	4,900	17 months
• Softener system	3,500	1,700	24 months
TOTAL	10,950	7,000	19 months

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Conserving Water, Energy and Chemicals at a Textile Dyeing Plant*. (www.unepie.org/icpic/icpic.html#technical).

India

Century Textiles and Industries Ltd

P² Technique: Material Substitution

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Century Textiles and Industries Limited was established in Bombay, India in 1897. Its Textile Division employs 7,000 workers. The company manufactures 100% cotton yarn and fabrics and is the world's largest exporter of 100% cotton fabrics. The turnover of the Textile Division for the year 1991-92 was US\$99.75m, with 80% of its production being exported. The company has won many national and international awards for export performance and energy conservation.

The company uses sulfur dyes that cause a pollution problem due to the traditional reducing agent used with them. Sulfur dyes are water insoluble compounds that have to be converted into water-soluble form and then into a reduced form having an affinity for the fiber to be dyed. The traditional method of taking the original dye to the affinity form is treatment with an aqueous solution of highly polluting sodium sulfide. This causes an increase in the sulfide content of the mill's effluent. On account of its toxicity the State Pollution Control Board prescribes a limit of 2ppm for sulfide in the treated effluent.

Hydrol, a by-product of the maize starch industry, which contained about 50% of reducing sugars was identified as a possible substitute to sodium sulfide. Experiments revealed that 100 parts of sodium sulfide could be substituted by 65 parts of this alternative plus 25 parts of caustic soda. The dissolving and the affinity are carried out in a single stage.

The substitution with hydrol was implemented with a redesigned mixing strategy. The dyeings obtained after this substitution were seen to be equivalent to conventional dyeings in depth of shades, fastness properties, etc., plus there were some other improvements in the quality of the dyed products. The process has been in use since April 1990. The substitution resulted in a slight increase in the biochemical oxygen demand (BOD) load on the plant but this increase was found not to be critical and was easily manageable with the existing biological treatment system.

Results

- No capital expenditure was involved in this substitution and in fact the operating costs were found to be marginally lower.
- Avoiding the installation of additional effluent treatment facilities saved about US\$20,000 in capital expenses and about US\$3,000 in running expenses per annum.
- The substitute chemical used was part of a waste stream from the Maize Starch industry, which saved them an estimated US\$12,000 in capital expenses with running costs at about US\$1,800 per annum.
- There was a reduction of sulfide in the effluent from 30 ppm to less than 2 ppm.
- There was less corrosion in the treatment plant due to reduced sulfide levels in the effluent.
- The foul smell of sulfide in the work place was eliminated.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Reduction of Sulfide in Effluent from Sulfur Black Dyeing*. (www.unepie.org/icpic/icpic.html#technical).

Kenya

Hotel Inter-Continental Nairobi

P² Techniques: Energy Efficiency, Material Substitution

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The Hotel Inter-Continental in Nairobi used to lose flash steam from its boiler due to excess steam in the laundry condenser. While replacing the hotel's 20 year old liquid water chillers, hotel management decided to remove the condenser from the discarded chillers and reuse it for the heat exchange unit in order to make substantial cost savings. Installing the heat exchanger recovered from the discarded chillers cost US\$2,000.

Water now enters the heat exchanger at 25°C where it is heated to 38°C. It is then pumped into the central water heater where it needs to be heated only another 12°C to reach 50°C. (Previously, water was heated directly in the heater from 25°C to 50°C). The boiler now efficiently operates at 50% capacity.

The cooling towers of the water-chilled air-conditioning system were replaced by those operated on two-speed motors and fans.

The hotel was also registering significant losses in voltage due to the high reactive power content when receiving power from the national grid. A capacitor bank was installed at a cost of US\$28,500 in order to improve the incoming power factor from 0.8 to 0.99.

Like most traditional refrigerators and freezers, this hotel's liquid chillers were operating on R12 which contains ozone-depleting CFCs. These chillers were replaced with more ozone friendly R134a at a cost of US\$200,000.

Results

- By using the heat exchanger recovered from the water chillers, US\$40,000 was saved for the cost of a new heat exchanger. In addition to this, fuel consumption was reduced by 24,000 gallons (US\$34,000/annum). Carbon dioxide and sulfur dioxide emissions were also reduced significantly.
- The increased power factor resulting from the installed capacitor bank resulted in energy savings of US\$20,400 per annum (18 months payback period). In addition to this, the capacitor bank does not use polychlorinated-biphenyl, a toxic chemical that cannot be properly disposed of at the end of its service life.
- The two-speed motors and fans installed in the air conditioning cooling towers operate at a lower speed and, therefore, save 8,000 kWh of energy per month. This equates to US\$8,400 savings in energy costs per year. The noise level of the towers has also been reduced by 60%.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Environmental Good practice in Hotels: Kenya*. (www.unepie.org/icpic/icpic.html#technical).

Mexico

General Instrument

P² Techniques: Process and Equipment Modernization

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This General Instrument facility produces cable TV converters. The manufacturing process consists of a wave soldering machine that generates waste composed of spent thinner and flux. The process used 1,1,1 trichloroethane (TCE) for cold cleaning of P.C. board.

Modern equipment was purchased and the manufacturing process was altered. The new process does not require the use of TCE and cuts solvent usage by half. The new machines have tighter programmable process controls.

Results

- TCE usage and waste was eliminated. Based on the previous year's TCE consumption, General Instrument saved \$10,038 per year. This resulted in an immediate payback for the company.
- General Instrument is also saving an additional \$6,600 on disposal costs.
- Employee health and safety was improved.

Source: Office of Pollution Prevention and Recycling, TNRCC. January 1998. *General Instrument/Jerrold Communications*.

Peru

City of Pisco's Fishmeal Industry

P² Techniques: In-Process Recycling

Contact Information: Environmental Pollution Prevention Project

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The United States Agency for International Development (USAID) in Peru has been supporting a project since November 1995 that provides P2 technical assistance to the fishmeal industry in the city of Pisco, located along the Paracas Marine Reserve, south of Lima, Peru. This project has resulted in the identification of significant P2 opportunities applicable to the entire Peruvian fishmeal industry.

Research carried out during this project revealed that a typical fishmeal plant in Peru that processes about 50 metric tons of fish per hour is losing about \$2.8 million per year in raw material. The losses consist of oil and protein that are discharged to the sea in the pumpwater used to pump the fish from the fishing vessels to the plant through submarine pipes. In addition to the economic losses, this pumpwater discharged to the sea is largely untreated and is the predominant source of contamination from fishmeal plants.

Technical consultants developed a pumpwater recycling system that recovers almost all the protein and oil that are currently being discharged to the sea in the pumpwater. This new system incorporates the protein and oil into the final product.

This recycling system consists of the installation of seven pieces of equipment, including the possible installation of additional evaporative capacity to handle the pumpwater concentrate produced after multiple recycling passes of the pumpwater through the system. The seven pieces of equipment include:

- A low friction PVC pipe to transfer fish from the chata (unloading station) to the plant,
- A submarine pipe to deliver used pumpwater back to the chata,
- A floatation system that removes oil and suspended solids from the pumpwater with each pass,

- Reconfiguration of pipes, valves and controls to accommodate changes in the pumping process consistent with recycling of the pumpwater,
- A buffer tank to check fluctuations in system flow, and
- A retention tank for receiving the recycled pumpwater when it can no longer be used and is ready to be evaporated.
- Depending on the recovery technology used and the evaporative capacity of the existing plants, an evaporation plant may need to be installed to handle the pumpwater concentrate produced after multiple recycling passes of the pumpwater through the system.

The initial capital cost for this recycling system at a typical plant in Peru ranges from \$630,000 - \$980,000. Based on these costs, the return on this investment ranges from 4 months to one year.

Equipment	Estimated Cost
Pipe for pumpwater return to chata	\$100,000
Dissolved air flotation system	\$150,000 - \$400,000
Reconfiguration of pipes, valves and controls	\$20,000
Buffer tank	\$10,000
Retention tank	\$50,000
Low water:fish ratio pump	\$150,000 - \$250,000
Low friction PVC pipe to transfer fish from chata to plant	\$150,000
TOTAL	\$630,000 - \$980,000

Requirement of an evaporation plant may increase costs by \$1 million and accounts for the range in payback periods.

Results

- Total value of raw material that could be recovered annually at a typical Peruvian fishmeal plant amounts to \$2,810,000. Reduced raw material purchases and increased yields of fishmeal and fish oil ensure that the investment costs are recovered within a year.
- Organic waste loads to the sea are eliminated.

Source: Hagler-Bailly Services, Inc.. 1998. *A Waste Recovery and Conversion System for the Fishmeal Industry*.

Philippines

Central Azucarera Don Pedro

P² Techniques: Process Modification, Good Housekeeping

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Established in 1927, CADP is the leading raw sugar factory in the Luzon Island of the Philippines. The plant now produces about 1,075 tons raw sugar at a rated capacity of 10 000 TCD. Enormous investments for the facility's Total Improvement Plan began in the 1987-88 crop year, with the acquisition of a Skoda mill from Czechoslovakia, capable of processing 8,000 tons of cane per day. CADP is now operating its new refinery, with a capacity of 550 tons of sugar per day.

The Pollution Management Appraisal (PMA) at CADP, conducted by the Industrial Environment Management Project (IEMP) in March 1993, focused on reduction in water use and wastewater generation. CADP significantly reduced its wastewater generation by adapting the IEMP recommended low cost/no cost waste minimization options. These included: waste segregation to dry handling of fly ash; recycling bagasse to absorb grease and oil spills; recycling clarified water from ash settling pond and condensate tank overflow for cleaning purposes; good housekeeping, such as monitoring oil spills, repair of leaking pumps, removing debris from canals.

CADP continues to study and implement waste minimization options. Each department now functions as an independent PMA team, investigating waste streams, checking pollution load, and recommending workable waste minimization options. CADP's chemical control and laboratory department reduced their consumption of lead sub-acetate, a toxic chemical used in the analysis of sugar content. CADP is hoping to totally eliminate lead sub-acetate by shifting to analytical instruments.

CADP's PMA team recognized the importance of tracking not only the process raw materials, but also the waste generation. Considering that water is a critical concern of the facility, CAD requisitioned an ultrasonic flowmeter at a cost of US\$13,100. The ultrasonic flowmeter's operating costs were US\$24,000. Such efforts allowed them to monitor sudden surges in the volume of the wastewater, immediately identify the cause of the rise in volume, and implement remedial measures.

Results

- Wastewater volume was reduced from 18,000 to 1,500 m³ per day.
- There was a reduction in lead sub-acetate consumption from 4.5 to 2-2.5 kg per day.
- These reductions resulted in reduced treatment, compliance and other liability costs amounting to savings of approximately US\$26,000 (payback period on investments of 9 months).
- Water consumption was reduced.
- Compliance with government regulations on effluent discharge was achieved.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Reducing Waste Generation in Sugar Milling and Refining*. (www.unepie.org/icpic/icpic.html#technical).

Poland

BORYSZEW SA Chemical and Plastics Company

P² Technique: Process Modification

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BORYSZEW SA Chemical and Plastics Company in Sochaszew, Poland specializes in the manufacture of auxiliary agents for the production and processing of plastics, products from polyvinyl chloride and high-and low-density polypropylene, anti-freezing fluids, polyvinyl acetate and glues for various uses, and pyrotechnic products. The company employs about 700 people and sells its products to both domestic and foreign markets. BORSZEW was privatized in 1992.

BORYSZEW operates a vegetable oil production plant. In the past, acetic acid was one of the raw materials used during the epoxidation reaction in the vegetable oil production process. The wastewater from the process contained 15-18 percent acetic acid which is extremely difficult to biodegrade. As a result the facility was discharging excessive amounts of contaminated wastewater to the river. The process also created explosion hazards in the vegetable oil production plant.

During the waste minimization project, efforts were directed toward finding a substitute for acetic acid that could serve as the oxygen carrier for the process. Several months of research and production trials resulted in identification of formic acid as a suitable substitute for acetic acid. Unlike acetic acid, formic acid decomposes easily by heating.

The raw material substitution did not require new equipment and the only costs incurred were those associated with the required research and production trials (US\$8,600).

Results

- A more efficient production process that saves raw materials and improves the quality of wastewater discharged into the river.
- Savings in material and compliance costs amounting to US\$165,000 per year (payback period on investment of less than 1 month).

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Substituting Acetic Acid by Formic Acid in a Vegetable Oil Plant*. (www.unep.org/icpic/icpic.html#technical).

Tanzania

Galco

P² Technique: Good Housekeeping, Process Modification

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At the beginning of March 1994, the Department of Environment in the Ministry of Tourism, Natural Resources and Environment launched a cleaner production pilot project in collaboration with the Ministry of Industries and Trade, the University of Dar es Salaam and the Ardhi Institute. The project, named CEPITA (Cleaner Environmental Production in Industry Tanzania), is funded by Danida.

Galco is a large company specializing in the manufacture of corrugated iron sheets and galvanized products. Continuous galvanizing operations involve degreasing, scrubbing, pickling, rinsing and fluxing, galvanization, cooling, chromating and drying.

The continuous galvanizing line in operation at Galco produces solid, liquid and gaseous wastes during the major processes of pre-treatment, galvanization and post treatment. As well as the loss of materials during processing, the wastes also cause water and air pollution. The company management decided to participate in the CEPITA project.

A waste minimization audit was carried out by the company in co-operation with cleaner production consultants to identify ways of preventing pollution, improving productivity, and improving the working

environment. Options identified for implementation within a year included: installing an ammonia fumes exhauster at the galvanizing unit, controlling the addition of ammonium chloride, and fixing the self-locking cocks (valves). Total capital investments for these options amounted to US\$1,547.

Longer term options included installing a steam return line, and changing to wet process - that is, the use of zinc chloride and aluminum chloride.

Results

- Material and compliance savings amounted to US\$700 (payback period of 2 years).
- Installation of the ammonia fume exhauster provides: a higher quality product, due to the reduction of heavy smoke which darkens the galvanized sheets; reduction in waste; improvements in the working environment; and a 40% reduction in ammonia emissions that averts the need to install expensive air pollution control system.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Ammonia Reduction in Galvanizing Steel*. (www.unepie.org/icpic/icpic.html#technical).

Tunisia

Leather Tanning Facility

P² Technique: Good Housekeeping, Process Modification

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The Environmental Pollution Prevention Program (EP3) in Tunisia was established in 1993. It has two main objectives: 1) the promotion of the concept and techniques of cleaner production within industry to reduce pollution and improve efficiency, and 2) the creation of a sustainable cleaner production program in Tunisia.

EP3 offers information, technical and analytical assistance to industries so as to facilitate the adoption of cleaner production approaches. In this case, a leather tanning facility was the subject of a pollution prevention diagnostic audit. This audit showed that the facility suffered from a number of pollution problems including:

- sulfide generation;
- excessive chromium discharge;
- excessive effluent volume;
- inefficient chromium fixation; and
- inefficient use of dye chemicals.

Four pollution prevention opportunities requiring an investment of US\$20,000 were identified to address these problems:

- separate the liming and washing wastewaters to eliminate sulfide generation;
- increase temperature and control the pH of the tanning baths to increase chromium fixation on the hides;
- recycle used chromium effluent with addition of one-third of initial requirements to reduce chromium discharge into the wastewater; and
- recycle used black dye solution with addition of one-half of initial requirements to reduce the dye discharge into the wastewater.

Results

- Production of sulfides and foul odors was eliminated.
- Chromium sulfate consumption was reduced to one-quarter of original consumption.
- Black dye consumption was reduced to three-quarters of original consumption.
- Chromium and dye recycling resulted in cost savings of US\$50,000 (5 months payback period on investment).

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Reduction of Toxic Wastes in the Leather Tanning Process*. (www.unepic.org/icpic/icpic.html#technical).

SECTION TWO

P2 Regulatory Integration in the United States

Alabama

P²-NET

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P²-NET is the internal pollution prevention roundtable of the Alabama Department of Environmental Management (ADEM). It is composed of representatives from ADEM's regulatory and non-regulatory programs. P²-NET's purpose is to implement the ADEM Pollution Prevention Policy of September 11, 1995. It was created to provide a forum for both management and staff to address two challenges to regulatory integration in ADEM:

- to demonstrate that pollution prevention could be adopted as a priority without diverting scarce resources from existing priorities; and
- to equip staff level employees with the tools and understanding to implement a voluntary, non-regulatory initiative that extends beyond their specific media focus.

Results

- Achieved formal adoption of the ADEM Pollution Prevention Policy.
- Reviewed and published 7 pollution prevention technical fact sheets.
- Facilitated the pollution prevention training of 103 ADEM inspectors.
- Developed a model pollution prevention Strategy and Implementation Plan.
- Committed to report pollution prevention progress through a department-wide, multi-media P2 annual report.

Source: Pollution Prevention Unit, Office of Education and Outreach, Alabama Department of Environmental Management. August 7, 1997. *P²-NET: A Regulatory Integration Project Case Study*.

Alaska

P2 in Compliance Consent Order

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Notices of Violation (NOV) represent an opportunity for compliance personnel to introduce P2 to businesses and agencies they regulate through consent orders. The Alaska Department of Environmental Conservation (DEC) applied this concept in the case of a federal facility's inadvertent discharge of algaecide into a drainage ditch, which resulted in the death of about 200 trout. As a result of the discharge, the DEC issued a NOV to the facility. The compliance consent order that was agreed upon included monitoring as well as P2 measures and best management practices. The goal was to address the root cause of the discharge, so that recurrence could be prevented through P2 measures.

The availability of algaecide was one of the factors that lead to the discharge, and so the first P2 element of the compliance order was for the facility to perform a chemical use assessment to reduce the quantity and types of chemicals at the facility. This led to a reduction of storage and use of 400 chemicals to 153 chemicals, and the capacity to continually reduce and eventually eliminate chemical use.

The facility also investigated substitute products that are less toxic than the algaecide that was discharged as part of the compliance order. This led to the facility substituting a mechanical cleaning system in place of chemicals to prevent build-ups in the power plant heat exchangers, which was the original reason for algaecide use.

DEC also negotiated with the facility to provide a process for recycling backwash from the waste treatment facility back into the process. This resulted in a reduction of chlorine content in the water treatment process, which allowed it to extend filter runs and reduce permitting costs.

Source: Pacific Northwest Pollution Prevention Resource Center. October 1997. *P2 in Compliance Consent Order*. Seattle, WA
Pacific Northwest Pollution Prevention Resource Center. July 1998 Edition. *Strategies for Promoting Pollution Prevention in the Pacific Northwest*. Seattle, WA

California

P2 Promotion via Accelerated Permit Review

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Production changes that require permit modifications are often difficult for industry to carry out because of protracted permit modification approval processes. Accelerating the review of permit modifications could act as an incentive for industry to implement P2 production changes. The MERIT Project in California offers expedited review of air permit modifications if P2 production changes are involved. This project has proved successful in encouraging P2 production changes.

For example, it has been successful in facilitating the implementation of P2 techniques and technologies in seven southern California metal finishing facilities. These facilities have decreased air emissions, and in most cases, achieved payback periods of less than 2 years.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.
Alice Tobriner. May 1998. *The Merit Partnership for Pollution Prevention*. EPA Region 9.

Colorado

P2 in Supplemental Environmental Projects

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Supplemental Environmental Projects (SEPs) are environmentally beneficial projects that a violator agrees to undertake, for which a reduction in the cash penalty of the enforcement action is awarded. P2 SEPs generally require a violator to reduce waste generation or releases to the environment beyond what is required by law. The violator is required to implement more pollution prevention projects than would normally be the case.

The CDPHE has incorporated SEPs into RCRA regulations, and first applied them to the hazardous waste violations of a bus manufacturer in 1995. As a result of the SEPs, the bus manufacturer purchased two enclosed paint gun cleaning units at a total cost of \$11,000 and improved its paint gun cleaning methods. These actions resulted in:

- a reduction of 100 drums/year (120 drums/year to 20 drums/year) in gun cleaning solvent waste generation;
- a decline in VOC emissions; and
- a \$11,000 reduction in the penalty paid to the State for past hazardous waste violations that was equivalent to the P2 investment.

In another case, a petroleum refinery invested \$1.8 million in a P2 project that resulted in the recovery of 50 barrels/day of liquid product, which is reprocessed into gasoline. This liquid product used to be burned, generating 24,000 lbs/year of carbon monoxide and 9,300 lbs/year of VOC emissions. The refinery has received an enforcement fine offset of \$500,000 for its pollution prevention investments that now total over \$3 million..

Source: Fred Dowsett. 1995. *Regulatory Integration Case Study*. Hazardous Materials and Waste Management Division, CDPHE.

Neil Kolwey. 1998. *P2 SEPs in Hazardous Waste Enforcement Actions*. Hazardous Materials and Waste Management Division, CDPHE.

Delaware

P2 Promotion Via Multi-Media Permits

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The majority of environmental operating permits are issued on a single media basis. This often results in cross-media transfers of pollutants. One of the goals of P2 is to reduce cross-media transfers, and multi-

media permits may be one way to achieve this. The DNRCC has a multi-media permit process that incorporates P2 assessment into permit applications. During the permit application process, the Department works with applicants to review each of the regulated pollutants for the possibility of pollution prevention, with the goal of permit avoidance. The main success has been the inclusion of pollution prevention assessment at the front-end of the permitting process.

The pilot facility, a medium-sized metal fabricator, submitted its multi-media permit application in 1995. The facility generates hazardous waste and is a TRI reporter. Its permitting issues were air and stormwater. In order for the facility to reduce air pollutants at their source, alternatives to the current vapor degreasing operations were explored. The alternatives identified were not feasible and so a CAAA Title V permit with multimedia considerations was issued.

Source: Pollution Prevention Program. June 1996. *Delaware Multimedia Management Pilot Project*. Delaware Department of Natural Resources and Environmental Conservation.

Illinois

P2 Promotion Via Expedited Permit Review

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Expedited review of permit modification applications is offered to facilities that implement P2 changes in their production processes. The Office of Pollution Prevention provides technical back-up to the company and agency permit writer in order to secure an expedited permit.

For example, Abbott Laboratories was able to quickly install new technology that allowed the company to move from a solvent-based to a water-based system in tablet manufacturing at its North Chicago pharmaceutical facility. Viskase Corporation received an expedited permit to build a prototype cellulose casing machine that will achieve a 98% reduction in VOC emissions compared to the current process at its Bedford Park facility.

Source: Kevin Greene. June 1998. *Illinois EPA Expedited Permit Program for P2 Projects*. Office of Pollution Prevention, Illinois EPA.

Indiana

P2 in Supplemental Environmental Projects

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In order to address environmental violations with timely, quality enforcement actions, the IDEM may reduce a facility's civil enforcement fine provided it undertakes environmentally beneficial expenditures which are not otherwise required by law (ie. SEPs). Pollution prevention, via input substitution, product reformulation, production process redesign, and in-process recycling, is one of the priority SEPs. The following are some of the several companies that have received P2 SEPs resulting in significant potential offsets of enforcement fines:

- Keil Chemical replaced sodium methoxide with calcium oxide as an input in its production process, and also instituted in-process recycling of ethylene diamine. This resulted in potential savings of \$1.5 million in enforcement fines.
- Four Winds International Corporation converted from solvent-based to urethane-based adhesives, and experienced a potential offset of \$40,000 in enforcement fines.
- Atlas Foundries installed an electrical melting system to reduce particulate matter emissions which resulted in potential enforcement fine savings of \$7,200.
- Hillcrest Manufacturing, Inc., converted to a water-reducible conversion varnish and experienced a potential offset of \$7,000.

Sources: Office of Enforcement, IDEM. July 1996. *Supplemental Environmental Projects*.
OPPTA, IDEM. 1996. *Annual Report on Pollution Prevention in Indiana*.

P2 Incorporation into State Rules

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Since July 1996, IDEM has studied the flexibility, multi-media impact, and pollution prevention incentives and disincentives of 75 rule and 17 non-rule policies published in the Indiana Registry. As a result of this, a new four-step approach will be employed in 1998 to address the incorporation of pollution prevention into rules:

- IDEM will work with EPA to review proposed federal rules to ensure they encourage pollution prevention before they are mandated to the state.
- External stakeholders will be invited to suggest ways to incorporate pollution prevention incentives into specific state rules that are being proposed.
- Various staff responsible for rule writing will consult with OPPTA when an opportunity to incorporate pollution prevention into a rule is identified; OPPTA staff will monitor rule summaries to identify pollution prevention opportunities.
- IDEM will request assistance from the Indiana University Fellowship Program to review existing rules in order to identify potential opportunities to include pollution prevention incentives.

Source: OPPTA, IDEM. 1996. *Annual Report on Pollution Prevention in Indiana*.

P2 Technical Support in Permit Applications

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The Compliance and Technical Assistance Program provides technical support for pollution prevention technologies to be included in air permits. A recent example of this has been in the fiberglass reinforced products industry. Due to the drastic changes in the calculations of emissions, the fiberglass reinforced products industry has had to identify new ways to greatly reduce emissions from their processes. Although control technologies have been used throughout the country, IDEM has chosen to focus on pollution prevention techniques. The Compliance and Technical Assistance Program has been able to provide information on available pollution prevention technologies and maintain involvement throughout the permitting process of several new fiberglass sources.

Source: Charles Sullivan. July 1998. *P2 Technical Support in Permit Application*. IDEM

P2 Prescriptions in Permits

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The prescription of P2 conditions in permits strays from P2 policy in the United States, which up to now operates on the notion that P2 should be voluntary and that industry should judge how and when to implement it. In Indiana, P2 permit prescriptions are applied to industries that emit VOCs, but are using materials substitution to comply with the state's non-control technology guideline RACT standard. This P2 prescription requires facilities to document reduction in use of VOC-containing materials, and is analogous to the reduction documentation required when using pollution control devices to achieve the required reductions.

P2 Promotion During Permit Inspection

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Permit inspectors are often well acquainted with the operations of regulated industries, therefore, the permit inspection process may be an effective tool for promoting P2. Inspectors in Indiana are trained in P2 techniques and distribute P2 information during inspections. In order to preserve their regulatory

enforcement role and to prevent duplication of the role of P2 technical assistant staff, inspectors are allowed to suggest operational improvements but not reengineering.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

Massachusetts

P2 Technical Assistance in Enforcement

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Enforcement personnel from the Department of Environmental Protection (DEP) and the Water Resources Authority refer companies that have been inspected to the Office of Technical Assistance (OTA) for P2 information. DEP and OTA conduct cross training in P2 and compliance with the aim of ensuring that the enforcement of regulations and the provision of technical assistance are harmonized. DEP inspectors receive training in spotting pollution prevention opportunities and OTA staff are trained to familiarize them with environmental regulations. This arrangement was driven by OTA's belief that companies pursue P2 initiatives primarily for compliance reasons, and DEP's belief that using P2 to improve environmental performance was worth the attempt.

Results

- This arrangement won the 1991 Ford Foundation Award for Innovation in Government.
- The majority of facilities that showed improvement in environmental compliance and P2 implementation have participated in both DEP inspections and OTA technical assistance.

Source: Rick Reibstein. August 1997. *Referrals to Confidential Technical Assistance from Enforcement Personnel: A P2 Regulatory Integration Case Study*. Massachusetts Office of Technical Assistance for Toxics Use Reduction.

Michigan

Clean Corporate Citizen Program

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The Michigan Clean Corporate Citizen (C3) program is a voluntary program that allows companies that have demonstrated environmental stewardship and a strong environmental ethic to be recognized as Clean Corporate Citizens. The C3 program requires environmental performance in three areas:

- *environmental management systems (EMS)* - C3 members should develop a strong and effective EMS that shall include, among other components, identification of environmental impacts, self-initiated compliance audits, and environmental training for employees;
- *pollution prevention* - C3 applicants are expected to develop a P2 policy and program to reduce waste at the source; and
- *environmental compliance* - C3 applicants must demonstrate consistent compliance with all applicable environmental requirements and have no outstanding unresolved violations.

C3 members are entitled to receive regulatory benefits, currently available in the air quality permit program. Benefits include:

- *expanded waiver provision* - allows C3 members to begin construction and operation while their permit is under review, and does not require them to show hardship would be created if the construction waiver is not granted;
- *expedited permit application review* - guarantees C3 members a response to their permit application within 30 days, provided the application is complete and does not require a public hearing; and
- *plant-wide applicability limit (PAL) permits* - allow C3 members to obtain construction permits for new processes as long as the emissions of the entire company stay below the established emissions cap. C3 companies are required to conduct monitoring and recordkeeping to verify that the PAL is being met.

Results

- As of August 25, 1997, four large companies had sent C3 applications.
- Development of an EMS appears to be the biggest obstacle for most potential applicants, especially small businesses.
- Some potential applicants are waiting until other media (water and land) are included in the C3 program before they apply.

Source: Environmental Assistance Division, Michigan Department of Environmental Quality. August 28, 1997. *Michigan's Clean Corporate Citizen Program*.

Minnesota

Permit Flexibility Via Pre-Approved Changes

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As a way to remove disincentives for P2, certain changes are pre-approved so that a facility is not required to go through the process of permit modification when it chooses to make these changes. This way, the permitting agency encourages specific kinds of P2 changes. Minnesota uses pre-approved permit changes as a way to reduce the disincentives for P2 at the 3M plant in St. Paul. Specific changes allowed to production lines are listed in the permits, however, 3M is required to notify the state permitting agency before making a listed change and after the change has been carried out. 3M can propose unlisted changes that are consistent with the listed ones, and can operate under the same permit if these are approved. 3M is now in a position implement P2 changes to its production lines without requiring permit modifications.

Permit Flexibility via Emission Caps

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Permit flexibility via emissions caps can be used as a reward for facilities that implement P2. The Minnesota Pollution Control Agency (MPCA) works with facilities to develop multimedia permits in which facilities agree to emissions reductions that are beyond the levels required by existing regulation. In return, the state will give those facilities greater operating flexibility using emissions caps. The 3M plant in Hutchinson is one of the facilities involved in this program.

Another company involved in this program is Onan Construction. It implemented a water-based/dipping process that allowed it to reduce VOCs/HAPs from 200 tons/year to 100 tons/year. For this, it received an expedited construction permit and a flexcap operating air permit.

Sources: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

Al Innes. July 1998. *Highlights of P2-Related MPCA Staff Activity: Current or in the Past Year*. Minnesota Pollution Control Agency.

P2 Evaluation for Permit Compliance

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In an attempt to make P2 an integral part of process design, Artistic Finishes, a wood finishing facility, was directed to conduct a study of P2 approaches to reducing VOC emissions. If the study identified acceptable input substitutes for VOC-containing materials, then the implementation of these would become an enforceable part of the permit. If no substitutes were identified by the study, the permit requires control-based approaches to be applied.

P2 Prescriptions in Permits

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Sheldahl, a manufacturer of electronic circuits, was issued a permit in 1991 that required the phase-out of methylene chloride in the entire facility. The permit did not specify what methods should be used, but a combination of prevention and substitution of a non-chlorinated VOC was used.

The 1998 Boise Solid Waste landfill permit requires that Boise look at other avenues (including P2) besides disposal for industrial waste.

MPCA requires all POTWs within the Lake Superior Basin to develop Toxics Reduction Plans as part of their NPDES permits. This requirement is aimed at reducing or eliminating toxic chemicals from POTW effluent discharges.

The air quality permit being developed for the Metro (Pigs Eye) Wastewater Treatment Plant incinerator includes a mercury reduction planning requirement that targets the Metro Plant's customers. It is hoped this requirement will significantly reduce the 300 pounds/year mercury emissions from the plant.

Sources: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

Al Innes. July 1998. *Highlights of P2-Related MPCA Staff Activity: Current or in the Past Year*. Minnesota Pollution Control Agency.

New Jersey

P2 Incorporation into State Rules

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In 1992, New Jersey amended the N.J.A.C. 7:28-8 rule entitled, "Permits, Certificates, Hearings and Confidentiality," and created a new rule. The amendments and new rule were intended to improve the overall effectiveness of the preconstruction permit program and to encourage facility-wide permitting under the New Jersey Pollution Prevention Act. The amendments and new rule classified certain changes made to equipment as "amendments" instead of "alterations," if the applicant had a "facility-wide permit" and meets other criteria in these rules. This change in classification meant that facilities could report equipment changes to NJDEP after they have been made. Previously, preconstruction review and approval was required before changes could be made. These rule changes made it easier for facilities to implement pollution prevention via equipment modification or modernization.

Source: NJDEP. September 1993. *Air Quality Regulation Program: Adopted Amendments (N.J.A.C. 7:28-8.1 and 8.3) and Adopted New Rule (N.J.A.C. 7:27-8.27) - Summary of Public Comments and Agency Responses*. New Jersey Register.

Facility-Wide Permitting

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The facility-wide permit program is a new regulatory approach being used by New Jersey to help facilities implement cost-effective pollution prevention strategies. This program aims to integrate the current fragmented permitting structure which sets different requirements for air, water and hazardous waste permits. One of the main goals of the program is to incorporate pollution prevention into a multi-media permit process. This is accomplished by requiring facilities to prepare a pollution prevention plan as part of the facility-wide permit application.

The Schering-Plough Corporation facility in Kenilworth was the first to be issued a facility-wide permit. Schering's pollution prevention plan determined that the use of TCE could be completely eliminated. By changing its label manufacturing process, Schering was able to reduce air emissions by about 6 tons annually and hazardous waste generation by 12 tons annually. Schering also determined that it could reduce the use of the CFCs Freon 11 and 12 by 20%, and reduce their generation by 60%.

Source: Melinda Dower. July 1998. *Facility-Wide Permitting: Fact Sheet Announcing the Issuance of the First Facility-Wide Permit*. NJDEP.

Permit Flexibility via Pre-Approved Changes

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New Jersey has incorporated pre-approved changes into permits for auto plants. Equipment changes such as that from manual painting operations to robotic spray painting (which is generally considered to be more efficient and a P2 change) are pre-approved in permits. This P2 incentive is only applicable to two facilities in the state, and information about whether it has been taken advantage of is not yet available.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

P2 Evaluation for Permit Compliance

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Air regulations instituted in New Jersey a few years ago require facilities to consider P2 options before a permit for pollution control options may be issued. New Jersey hopes that this will make industry reassess the way it does business.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

P2 Prescriptions in Permits

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Permits issued to asphalt manufacturers in New Jersey require them to have plans for reductions of carbon monoxide and hydrocarbon emissions, and to report quarterly on good operating practices being applied.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

New York

P2 Promotion via Integrated Environmental Reporting

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DEC is evaluating various integrated environmental reporting initiatives. These initiatives have common elements such as reducing the amount of information requested, minimizing data duplication, reducing reporting frequency, automating data storage and submittal, and making information more easily and widely available to government, permitted parties, and the general public.

The PPU has already participated in the EPA's Facility Identification Initiative, which establishes a single unique identifier for regulated facilities that will allow data about facilities to be more easily assembled and which support EPA's "One Stop Reporting" and other similar initiatives.

Source: PPU. July 1997. *1996 Annual Report: Multi-Media Pollution Prevention in New York State*. New York State Department of Environmental Conservation.

P2 Promotion via Integrated Facility Management

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Integrated facility management (IFM) involves a team of DEC regional staff from all relevant environmental quality units working together to assemble and assess all pertinent information, coordinating media inspections usually at a single point in time, and then comprehensively evaluating each selected industrial facility. IFM allows for the efficient assessment of overall facility regulatory compliance, produces opportunities for identifying and implementing pollution prevention improvements, and helps to avoid inadvertent cross-media pollutant transfers.

By March 1997, there were 80 facilities involved in IFM. Of these facilities, 11 had completed inspections, 7 had completed draft or final evaluation reports, and 10 had pollution prevention programs planned or established by December 1996. Besides resulting in a higher frequency of compliance, IFM also produced better communication and joint problem solving between DEC and facilities, which in turn produced more and better pollution prevention and other environmental improvements.

Source: PPU. July 1997. *1996 Annual Report: Multi-Media Pollution Prevention in New York State*. New York State Department of Environmental Conservation.

P2 Promotion via Multi-Media Permits

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In an attempt to reduce unnecessary costs associated with permitting targeted at a single environmental medium, New York State has reduced duplications in environmental permitting and increased the speed and efficiency of the permit process by introducing multi-media permits. The multi-media permit has the benefit of providing operational flexibility to facilities, promoting pollution prevention and promoting compliance at less cost than the multi-permit system.

The General Electric (GE) Silicones Plant in Waterford is the pilot facility being used to test the multi-media permit process. Working with GE, the DEC developed a comprehensive inventory of regulated activities at the facility and evaluated the merits and feasibility of promoting pollution prevention through an integrated facility permit process. Ways to streamline the permit process and to fully incorporate pollution prevention planning into the permit process were examined.

The evaluation report for this GE-Waterford pilot project is currently being reviewed by DEC.

Sources: PPU. Undated. *Multi-Media Pollution Prevention Oriented Permitting Pilot Project*. New York State Department of Environmental Conservation.

PPU. July 1997. *1996 Annual Report: Multi-Media Pollution Prevention in New York State*. New York State Department of Environmental Conservation.

North Carolina

P2 Promotion via Reduced Monitoring

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The opportunity to do less monitoring and record keeping may be used as an incentive for companies to implement P2. The idea behind this method is that companies that implement P2 and are well below regulatory thresholds pose minimal hazards to the environment and can therefore be monitored less strictly. Companies in North Carolina that demonstrate the implementation of P2 changes in their production processes, may not be required to keep records on usage and emission factors or monitor for emissions. State RACT rules allow the use of low VOC-emission coatings for various industries as an alternative to prescribing a numerical daily emissions limit. Keeping record of daily coating use is therefore reduced to merely demonstrating use of one of the compliant coatings.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

Ohio

P2 in Supplemental Environmental Projects

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SEPs aim to integrate P2 into the enforcement of Ohio's existing environmental regulations. A growing number of P2 SEPs are being incorporated into enforcement cases (64 so far).

One such case involved a metal finishing plant implicated in hazardous waste handling and management violations. As a result of a P2 SEP, the plant witnessed considerable improvements in its operations and saved approximately \$111,400 in areas such as utilities conservation, hazardous and solid waste reduction, and improved fluids management. The plant's pollution prevention program also earned it a 12% reduction in penalties from the Ohio EPA.

Another case involved a shoe preserver that had been involved in VOC emission violations. As a result of a P2 SEP, the shoe preserver was able to achieve source reduction of daily VOC emissions from 40 pounds to less than 5 pounds by switching from a solvent-based copper dip to a water-based copper dip. This reduction led to its exemption from pollution control laws, and a 25% penalty mitigation by the Ohio EPA.

One other case involved a rubber manufacturer that had violated hazardous waste management standards by allowing oil mist to escape the lathe machines. The P2 SEP required the rubber manufacturer to install a Theil oil mist eliminator at a cost of \$13,600. This resulted in savings of \$9,365 annually (17 months payback) in disposal charges, raw materials and labor, and a 25% penalty mitigation by the Ohio EPA.

Source: Office of Pollution Prevention, Ohio EPA. September 1997. *Pollution Prevention in Enforcement*.

Oregon

P2 Planning Requirements in Permits

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P2 incentives can be built into permits by using plant-wide emission limits versus point-by-point limits. This provides an incentive to a business to find the least-cost and often P2 solution to meet an overall limit.

- A large fiberglass manufacturing facility in Oregon that emitted high levels of styrene was subject to prevention of significant deterioration (PSD) and BACT standards. The Oregon Department of

Environmental Quality (DEQ) required this facility to install add-on controls within three years to reduce styrene emissions. In order to reduce styrene emissions in the interim, the facility agreed to investigate P2 measures. The framework for P2 implementation was specified in a permit issued by DEQ. This framework required the facility to submit a pollution prevention report to DEQ quarterly detailing progress made with VOC-related P2 measures.

As a result of the P2 requirement in the permit, the facility completed a Pollution Prevention Plan and implemented several P2 measures. Source tests showed that the P2 measures accounted for at least 40 percent of reduction in emissions. P2 measures, in combination with an 85 percent emissions reduction resulting from add-on controls, are expected to result in a 90 percent overall reduction in emissions.

- Intel, a semiconductor manufacturer, has also been issued a Title V permit through the Intel P4 Project which requires specific elements of a P2 plan to be developed. Pre-approved changes in VOC emissions in the permit require the maximum capacity of each stationary source not to be exceeded, pollution control equipment not to be changed or degraded, and the plant site emission limit not to be exceeded. The project also allows pre-approved changes of HAP emissions as long as the total emissions of organic and inorganic HAPs do not exceed 10 tons per year each. This ensures that the facility will never become a major HAP source. In order for Intel to increase productivity and remain within emission limits, it will have to incorporate P2 into its processes.

Sources: Pacific Northwest Pollution Prevention Resource Center. October 1997. *P2 in MACT: Fiberglass Manufacturing Facilities in Oregon*. Seattle, WA

Pacific Northwest Pollution Prevention Resource Center. July 1998 Edition. *Strategies for Promoting Pollution Prevention in the Pacific Northwest*. Seattle, WA

VOC Limited Amnesty Project

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P2 incentives can be incorporated into enforcement in several ways. One way is to use P2 SEPs to mitigate penalties, and another is to provide limited amnesty for businesses subject to regulations if they adopt P2 measures.

One of the problems faced by enforcement officials is finding and permitting non-permitted sources of pollution. DEQ created the VOC Limited Amnesty Project because it was concerned that many small sources of VOCs were operating without an air permit, either because they were unaware of the VOCs they were producing and the permit requirements, or because they did not inform DEQ of their emissions. This project was initiated in 1995 and was intended to bring sources in the Portland Air Quality Maintenance Area (AQMA) into compliance and reduce VOC emissions through P2.

The project offered Portland businesses amnesty from civil penalty if they voluntarily agreed to conduct a P2 assessment to determine if VOC emission could be reduced and obtain an air permit if necessary. DEQ contacted 850 businesses whose Standard Industrial Classification (SIC) codes indicated that they might emit VOCs. More than one-third of the businesses responded to DEQ's request for an emissions inventory. DEQ informed these businesses of the project requirements and gave them one month to sign a Participation Agreement with DEQ.

Facilities meeting the following requirements were allowed to participate in the amnesty project:

- Businesses must be located in the Portland AQMA;
- Annual VOC emissions, before controls, must exceed 10 tons per year;
- Annual VOC emissions must not exceed the threshold for New Source Review; and
- Annual emissions must be below major source levels defined in the Clean Air Act.

The amnesty project guidelines required businesses to conduct a P2 assessment which, upon completion, would lead to the signing of a Consent Order with DEQ. The Consent Order required a schedule for using P2 alternatives that would reduce VOC emission to below 10 tons per year, or a schedule to allow participants to continue operating without an air permit until one was obtained.

A total of 22 businesses participated in the amnesty project. Seven of them were able to reduce VOC emissions below 10 tons per year and avoid air permit requirements through the use of P2 measures. The other 15 obtained air permits, and where feasible, implemented P2 techniques. The total reduction in VOC emissions from the 22 sources was about 70 tons per year. DEQ believes that this project was successful in reaching a majority of non-permitted sources at a relatively low cost, while promoting P2.

Source: Pacific Northwest Pollution Prevention Resource Center. October 1997. *VOC Limited Amnesty Project*. Seattle, WA
Pacific Northwest Pollution Prevention Resource Center. July 1998 Edition. *Strategies for Promoting Pollution Prevention in the Pacific Northwest*. Seattle, WA

Texas

P2 in Supplemental Environmental Projects

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The TNRCC allows for the use of SEPs in enforcement actions. Pollution prevention is one of the preferred SEP options because it will directly benefit the environment in the community where the alleged violation occurred. P2 SEPs require the reduction of pollutants reaching the environment beyond any amount essential to comply with environmental laws or other commitments. A company's willingness to make voluntary contributions to SEPs may result in a reduction of less than 50% of its recommended administrative penalty.

Source: TNRCC. October 1995. *Environmental Enforcement Policy Statement: The Use of Supplemental Environmental Projects in Settlements*.

Flexible Permit Program

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This voluntary program was established by TNRCC rule in 1994 to provide for a single permit that establishes plant wide emission caps for various pollutants. The emission caps are decreased over a ten year period until the facility achieves emission reductions that are equivalent to installing BACT controls on all emission points. This program provides an opportunity to convert existing air permits, standard exemptions and grandfathered facilities into a single flexible permit. One of the ideas behind a flexible permit is that it allows a facility to phase in pollution prevention projects so that costs can be managed over time.

Results

- Eleven flexible air permits have been issued by the TNRCC.
- The companies involved made binding commitments to reduce 116 million pounds of emissions annually in return for operational flexibility.
- These permits allow a company to make permit and equipment changes with reduced processing as long as total emissions at the company remain below allowable levels.

Source: Johnny Vermillion. August 1997. *Texas Flexible Permit Program*. Office of Air Quality, TNRCC.

P2 Regulatory Integration Action Plans (1998-2000)

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The TNRCC conducted the first P2 Integration Summit in January 1998, involving over 60 representatives from across the agency. Several project plans were developed to integrate P2 into the TNRCC's various regulatory programs. P2 Action Teams responsible for implementing these project plans will report to TNRCC's P2 Steering Committee every six weeks and provide a project update to the Commissioners and Executive Director in June and December of each year. The following are *some* of the fourteen (14) P2 Priority Projects touching on a wide range of the TNRCC's regulatory work:

- **Enforcement P2** - Integrate P2 measures into the enforcement process and provide staff training and P2 tools. Specific activities include amending the SEP fact sheet to include P2 and promote P2 SEPs early in the development of a formal enforcement action. Implementation time line: 2/1/98 - 2/1/2000.
- **New Source Review (NSR) Air Permitting Program** - Train NSR staff and the regulated community regarding the integration of P2 into the permit review process, and add P2 as the primary tier in the existing 3-tier BACT review. Proposed steps include, incorporating P2 into pre-permit meetings and revising permit guidance documents, application forms, and technical review documents. Implementation time line: 2/1/98 - 2/1/99.
- **Industrial and Hazardous Waste Permits** - Create a coordinated effort to integrate P2 into pre-permit meetings, the permit renewal process and encourage P2 Site Visits for permit writers. Applicants will be encouraged to identify source reduction and waste minimization opportunities at the earliest stage of permit development or six months prior to the permit renewal call-in date. Implementation time line: 3/1/98 - 8/31/98.

- Water Quality Division Permits - Develop and include P2 assessment requirement in all wastewater permit applications. Staff is using the wastewater self-reporting data to identify facilities for P2 technical assistance. The date will be used to identify facilities that may be close to exceeding permit requirements and contact them for voluntary P2 technical assistance to reduce discharges. Implementation time line: 4/1/98 - 8/31/99.

- Policy and Regulatory Development - Conduct a pilot project to review, amend or create rules to improve overall environmental quality through P2 initiatives. The TNRCC's Rules and Policy Review Committee has revised its Rules Action Form to designate which rules have P2 opportunities. For a rule that has significant prevention opportunities a cross-agency team will be assigned to draft the rule. Implementation time line: 6/1/98 - 8/31/98.

Source: P2 Steering Committee, TNRCC. May 1998. *Action Plan for Integrating Pollution Prevention into TNRCC's Regulatory Programs*. TNRCC.

Virginia

P2 Incorporation into RCRA Compliance Inspections

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Virginia has a program that assists regulated facilities in their P2 activities and encourages compliance assistance via P2 actions. The Virginia OPP has a program that educates DEQ's hazardous waste RCRA inspectors how to assist regulated facilities to recognize and implement P2 opportunities. Inspectors are trained to gather information and conduct P2 assessments. Then joint inspections are held in which OPP staff accompany RCRA inspectors on facility visits. These joint inspections allow OPP staff to conduct P2 assessments during RCRA compliance inspections so that various techniques to recognize P2 opportunities are demonstrated.

Results

- An increase in the number of requests for P2 technical assistance.
- Several facilities were able to become small quantity generators as a result of the program.
- Several opportunities for reductions in air emissions and water effluent discharges, water conservation, and energy savings have been identified as a result of this program.

Source: William Sarnacky. August 1997. *Incorporating Pollution Prevention Assessment Opportunities into RCRA Compliance Inspections in Virginia*. Office of Pollution Prevention, Virginia Department of Environmental Quality.

Washington State

Toxics Reduction Engineering Exchange (TREE)

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The TREE project is being established to provide resource efficient and cost effective prevention practices to permitting agencies and industrial facilities with rinsing processes. This project hopes to promote P2 through specific, in-depth, on-site technical assistance. It intends to achieve this by providing industrial facilities with detailed process engineering, business analysis and cost information, and close coordination with water quality permit staff. It also hopes to equip water quality permit staff with P2 technical assistance skills that they would then disseminate to industrial facilities.

Source: Hugh O'Neill. May 1998. *Promoting Multi-Media Pollution Prevention: Request for Approval of "PEAKART."* Washington State Department of Ecology.

P2 in NPDES Permit Renewals

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The Washington Department of Ecology (WDE) is pursuing the use of NPDES permit renewals to promote P2 practices among permitted sources. The NPDES permitting system has been used to reduce and eliminate point source pollutant flows to surface water bodies from two steel mills, the Boeing Company, and numerous smaller industries in Washington state.

WDE's approach was to include basic P2 language in to the NPDES permit and work cooperatively with the permitted facilities. The P2 language in the permit requires "a report on all wastewater discharges which, at a minimum, includes:

- A complete inventory of all waste streams;
- Daily average and maximum flow rates for each waste stream;
- A detailed investigation into the options available for reduction, recirculation, reuse, or elimination;
- Selection of a preferred option; and
- A schedule for implementation of the preferred option."

Through the use of P2 in NPDES permits, several facilities achieved zero discharge and thus NPDES permit cancellation. Salmon Bay Steel eliminated 4 million gpd of rolling mill process wastewater. Jorgensen Forge eliminated 100,000 gpd of vacuum degas wastewater and quench tank discharge. Several Boeing facilities eliminated wastewater discharges:

- the Auburn facility eliminated 370,000 gpd;
- the Developmental Center eliminated 600,000 gpd;
- the Kent Space Center eliminated 400,000 gpd;
- the North Boeing Field eliminated 250,000 gpd;
- the Plant II eliminated 800,000 gpd; and
- the Renton facility eliminated 500,000 gpd.

Source: Pacific Northwest Pollution Prevention Resource Center. December 1997. *P2 in NPDES Permit Renewals*. Seattle, WA
Pacific Northwest Pollution Prevention Resource Center. July 1998 Edition. *Strategies for Promoting Pollution Prevention in the Pacific Northwest*. Seattle, WA

West Virginia

P2 Evaluation for Permit Compliance

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The West Virginia Air Toxics Law requires facilities to consider source reduction before permits are issued for pollution control devices. It targets 14 chemicals and calls for the use of the Best Available Technology (BAT) in 41 facilities in the state. "Best" in BAT has been redefined as chemical elimination. The state offers technical assistance to these facilities before permit submission.

The result has been 26 facilities eliminating all use of the chemical that subjected them to this law. Also, 15 facilities have implemented BAT plans, many of which require some form of chemical elimination and control.

Sources: Susan April. April 1998. *Reinterpretation - Key to P2?* (Presented at the National Pollution Prevention Roundtable's Spring 1998 Conference). Kerr, Greiner, Anderson & April, Inc.

Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

Wisconsin

P2 Planning Requirements in Permits

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Permittees are required to carry out a Chloride Reduction Study (CRS) for all wastewater discharges covered by the Wisconsin Water Pollution Discharge Elimination System (WPDES) permit. As one of its key elements, the CRS requires the identification and quantification of chloride sources at a facility and an estimation of the amount of chloride reduction that is economically feasible using source reduction measures.

The CRS is being applied to permits in the dairy sector and for POTW permits. For example, Wooden Tank Farm was required to use pollution prevention techniques and equipment to minimize spillage during salt transfer.

Wisconsin DNR also requires WPDES permittees to develop and submit a cost-effective pollutant minimization program which aims to reduce all sources of mercury in wastewater. In developing this program, the permittee is required to investigate various pollution prevention techniques.

Source: Jerry Rodenberg. July 1998. *P2 in Permits* (Presentation material sent to NPPR). Wisconsin DNR.

P2 Promotion Via Reduced Permit Fees

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Another method of promoting P2 is to offer reduced permit fees to facilities that demonstrate implementation of P2 in their activities. Wisconsin has been able to apply this method, and reduced reporting requirements, to its stormwater permits. Facilities that show reduced contamination of, or uncontaminated, stormwater runoff are eligible for reduced monitoring and up to \$200 reductions in their annual stormwater permit fees.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

P2 Promotion By Extending Compliance Time

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Wisconsin water quality permit applicants are allowed extended compliance time if they intend to implement P2. The short term environmental hazards of extended compliance schedules may be weighed against the long term benefits that result from the implementation of P2 as opposed to pollution control.

Source: Melissa Malkin, Jesse Baskir and Aarti Sharma. September 1995. *State Experience Integrating Pollution Prevention into Permits*. Research Triangle Institute.

International P2 Regulatory Integration

Denmark

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Denmark has a clear policy and strategy for cleaner technology and many initiatives have been started within this strategy.

The first Environmental Protection Act was passed in 1973 and came into force from 1 January 1974. In this law the environmental strategy contained among other things the polluter-pays principle, and the principle that industry should use the best available technology in production. The key approaches used to promote cleaner technology are:

- Regulatory Instruments: Seriously polluting companies (listed activities) in Denmark must apply for pollution permits under the approval scheme from the environmental authorities when establishing or extending their production activities. The regulatory instruments require that the polluting companies include statements and documentation of the use of cleaner technology in the application for pollution permits
- Financial Instruments: In Denmark financial instruments in relation to cleaner technology comprise both taxes, duties and fees ("stick") and grants and subsidies ("carrot").
- Information and Education Instruments: There have been sector survey projects in several industrial sectors: iron and metal, wood and furniture, fish and shrimp-processing, dairy, textiles, graphic/printing, electronics, paper, concrete, breweries, etc. These surveys were used to identify technological development and demonstration projects. The technological development projects are typically projects that develop less pollutant technology, materials and products to be used by several industries in each sector. The implementation and demonstration projects involve the actual introduction of new cleaner technology processes or materials and products in a company.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Policy Case Studies - Denmark*. (www.unepie.org/icpic/icpic.html#technical).

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French environmental policy has adopted the concept of cleaner technology and aims to prevent or reduce pollution at its source, mainly via process modification and modernization. Within the Ministry of the Environment is the Department of Cleaner technology and Wastes, which is in charge of managing waste management policy and detailing suitable instruments.

There also exists the Agency for the Environment and Energy Management (ADEME - French acronym). ADEME, through its Department of Industry, Cleaner Products and Cleaner Technology, is in charge of information, stimulation, technical and financial assistance for cleaner technology and waste minimization programs.

Regulatory instruments for cleaner technology implementation were passed with pollution prevention legislation in March 1993. These instruments call for the consideration of cleaner technology on an equal footing with waste minimization measures such as the development of recycling techniques.

Financial instruments for cleaner technology implementation include up to 50% subsidies from ADEME and Water Agencies for the cost of process modifications. Between 1992 and 1993, ADEME provided financial assistance for 10 cleaner technology demonstration projects amounting to FRF 6 million. Water Agencies also provide low interest loans for industries undertaking process modifications. Proceeds from water consumption and pollution taxes and landfill taxes are used to fund the development of cleaner technology and cleaner products among other things.

Information and education instruments for the implementation of cleaner technology include distribution of cleaner production publications to industries and development of cleaner technology educational guides for industries and university engineering students.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Policy Case Studies - France*. (www.unepie.org/icpic/icpic.html#technical).

Malaysia

The Environmental Impact Assessment Order

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The *Environmental Impact Assessment Order* of 1987 was one of the first few pieces of legislation to require preventative planning to be built into new development projects. It identifies 19 prescribed activities that require an environmental impact assessment (EIA) for approval of development. These activities are: agriculture, fisheries, forestry, quarries, mining, petroleum, water supply, drainage and irrigation, land reclamation, housing, resort and recreational development, industry, infrastructure, ports, airport, power generation, transportation, railways, and waste treatment and disposal.

The EIA process requires the project proponent to submit a report on the assessment of the impacts and potential impacts of the project activity on the environment, and may require that measures be taken to prevent these impacts. The prescribed activities can only be carried out after the report has been approved by the Director General of the Environment.

Higher penalties have been established for pollution violations. A provision has been made to allow the Department of Environment to collect an environmental tax on wastes generated by industry for an environmental fund that will be used to support research, conservation and pollution prevention.

The National Environmental Policy defines a Green Strategy that aims to integrate environmental considerations into all developmental activities and decision-making processes. Out of the seven strategies defined under the Green Strategy the use of cleaner production is strongly emphasized under the 4th Strategy: Prevention and Control of Pollution. Industries, especially larger ones, are encouraged to prevent pollution through the use of cleaner technologies, and develop and implement Environmental Management Systems (EMS).

Source: Marina Yong. *Promoting Pollution Prevention in Malaysia: Current Legislation and Lessons from the U.S. Experience*. Journal of Ensearch (Special Issue on Cleaner Production); vol. 11, no. 1/2; March/June 1998.

The Netherlands

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The following are some of the instruments by which pollution prevention is integrated into existing environmental regulation:

- **Regulatory Instruments:** In the late 1980s, the authorities integrated separate laws and permits into one law ("Wet Milieubeheer") with the exception of the Law on the Pollution of Surface Water. In the new law, there are several options to integrate pollution prevention in permits.
- **Financial Instruments:** The national authorities have established various subsidy schemes encouraging the development and implementation of environmental technologies. There are taxes on the use of raw materials such as ground water, fossil fuels and mineral oils, and on the disposal of solid waste and wastewater. These are collected by both national and regional/local authorities.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Policy Case Studies - Netherlands*. (www.unepie.org/icpic/icpic.html#technical).

The Peoples' Republic of China

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The promotion of cleaner production via its incorporation into existing environmental regulations and instruments is one of the policy suggestions and action plans mentioned in the National Environmental Protection Agency (NEPA) Administrative Document #232 (April 1997). This document calls for the use of cleaner production assessments in the environmental impact assessment process and the integration of cleaner production in permitting and compliance.

Several provincial cleaner production centers and cleaner production promotion offices have been set up in local Environmental Protection Bureaus (EPBs). Some local governments, such as Shaanxi Provincial Government, Benxi Municipal Government, etc., have made policies to return to enterprises a certain percentage of pollution levies in return for conducting CP audits.

Article 25 of the Environmental Protection Law requires the developers of new enterprises or existing enterprises making technological renovations to install equipment and processes which use resources highly efficiently and generate less waste.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Policy Case Studies - China*. (www.unepie.org/icpic/icpic.html#technical).

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Cleaner technology has only been indirectly included in environmental and industrial legislation in Spain. There is no explicit cleaner technology legislation for industrial production processes. Spain's foremost cleaner technology program is the Environmental Program for Industry and Technology (PITMA - Spanish acronym) launched by the Ministry of Industry, Commerce and Tourism in 1989.

PITMA promotes solutions to industrial pollution problems and stimulates growth in the environmental sector via technical assistance and funding programs. PITMA provides 30% to 60% subsidies for costs of small and medium-scale industries attempting to implement cleaner production methods.

Information and education instruments used to implement cleaner technology methods include the MEDIA project focussing on waste minimization. Five enterprises participated voluntarily in the pilot study. Of the 40 options identified for waste minimization, 22 (55%) involved source reduction.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Policy Case Studies - Spain*. (www.unepie.org/icpic/icpic.html#technical).

The United Kingdom

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Although UK environmental policy does not explicitly refer to cleaner technology, its first priority is waste minimization, which is defined as source reduction. Environmental policy calls for a priority on waste prevention rather than waste treatment.

The UK strategy on waste minimization involves raising awareness about its economic and environmental benefits. It also involves legislation to restrict options and increase costs for waste disposal and to discourage pollution through criminal and civil liability. Support for demonstration and research and development projects is offered in the form of grants.

Cleaner production policy measures in the UK come under the Environmental Protection Act of 1990. This act introduced the concept of Integrated Pollution Control (IPC), which requires seriously polluting commercial, industrial and other processes subject historically to separate legislation relating to the protection of air, water, or land to seek a single authorization from Her Majesty's Inspectorate of Pollution to continue operating. All new facilities or processes in the sectors specified for IPC require such authorization before they can begin operating. IPC has presented a mechanism by which to prevent cross-media pollution transfer.

Cleaner production financial instruments aim at making waste producers face the full costs of waste disposal and any associated environmental costs, as well as encourage waste minimization and recycling.

Information and education instruments raise awareness of waste minimization by stressing its economic benefits. They also make cleaner production literature available to industry.

Source: United Nations Environment Program - Industry and Environment, Cleaner Production Program. 1998. *Policy Case Studies – United Kingdom*. (www.unepie.org/icpic/icpic.html#technical).

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THE FUTURE OF THE PAPER INDUSTRY

Introduction

The paper industry has been a cornerstone of human civilization for centuries. It has played a vital role in the development of writing, printing, and communication. However, in the 21st century, the industry faces significant challenges and opportunities.

Environmental Impact

The paper industry is a major consumer of natural resources, particularly water and energy. The production of paper involves a complex process that generates significant greenhouse gas emissions. Additionally, the industry is a major source of deforestation, which has led to the loss of biodiversity and the degradation of ecosystems. However, the industry is also a major employer and a significant contributor to the economy.

Technological Advancements

Recent technological advancements have led to significant improvements in the efficiency and sustainability of paper production. For example, the use of recycled paper and the development of new paper grades have helped to reduce the industry's environmental footprint. Additionally, the use of digital printing technology has led to a significant reduction in waste and energy consumption.

Market Trends

The paper industry is facing a number of challenges in the current market environment. The demand for paper is declining in many developed countries, while it is increasing in emerging markets. Additionally, the industry is facing increased competition from other materials, such as plastic and metal.

Conclusion

The paper industry is a complex and dynamic sector that is facing significant challenges and opportunities. While the industry has made significant progress in recent years, there is still much work to be done to ensure its long-term sustainability. By embracing technological advancements and adopting sustainable practices, the industry can continue to play a vital role in the global economy.

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2021

The Paper Industry Association is a non-profit organization that represents the interests of the paper industry. It is committed to promoting the sustainable development of the industry and to ensuring that it remains a vital part of the global economy.



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